FISKE FUND PRIZE DISSERTATION, No. XXXVI.

NEW AND ALTERED

FORMS OF DISEASE,

DUE TO THE

ADVANCE OF CIVILIZATION IN THE LAST HALF CENTURY.

BY

HOBART AMORY HARE, M.D. (Univ. of Pa.), B.Sc.,

DEMONSTRATOR OF EXPERIMENTAL THERAPEUTICS AND INSTRUCTOR IN PHYSICAL DIAGNOSIS IN THE UNIVERSITY OF PENNSYLVANIA; PHYSICIAN TO THE CHILDREN'S DISPENSARY OF THE UNIVERSITY HOSPITAL AND TO ST. CLEMENTS' DISPENSARY.

PHILADELPHIA:
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THE Trustees of the Fiske Fund, at the annual meeting of the Rhode Island Medical Society, held at Providence, June 10th, 1886, announced that they had awarded a premium of two hundred dollars to an essay on "New and Altered Forms of Disease, Due to the Advance of Civilization in the Last Half Century," bearing the motto—

"Times change and we change with them."

The author was found to be HOBART AMORY HARE, M.D., of Philadelphia, Pa.

HORACE G. MILLER, M.D., Providence,
ALBERT POTTER, M.D., Providence,
JOHN W. MITCHELL, M.D., Providence,
Trustees.

G. L. COLLINS, M.D., Providence,
Secretary of the Trustees.

PREFACE.

A strict interpretation of the title of this paper has prevented the writer from considering certain subjects which are not due to the advance of civilization, but are rather the things in connection with disease which our increased knowledge has brought before us of late years. Chief among these is the entire realm of bacteriology, which has probably existed for ages, but has only been in existence to *our knowledge* for a very short time. For this reason, also, a consideration of the errors of refraction in the eye has not entered these pages, since the frequency of this lesion at the present day only seems greater because a greater number of persons use their eyes for reading or other fine work. The very fact that errors of refraction are common among wild races of men, and animals, both domestic and wild, proves that a discussion of such a character would here be out of place. In two cases only has the writer departed from the path laid out for him; namely, the consideration of actinomycosis and trichinosis. These two diseases, while probably of ancient origin, have only been recognized of late, neither the diseases themselves nor the minute organisms causing each having been understood or even thought of till the time of the present generation.

With one or two exceptions, the increase in the frequency of a disease has not been considered of sufficient moment to bring it under the term of "altered form," and for this cause certain diseases whose history is as old as history have been left out.

The most important and interesting diseases, and the ones which are the most suited to this paper, are caisson disease and phosphor-necrosis; for these are they which seem, of all others, to have arisen from the recent advances of civilization.

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As civilization increases from year to year it necessarily brings about changes in the habits, customs and surroundings of the people, and this being the case it is not a difficult matter to understand how many of the diseases from which our forefathers suffered have changed their form, owing to the changes which have been brought about in their birthplaces and in the systems of their victims. As each year goes by new processes of manufacture, etc., come into use, many of which are injurious, either directly or indirectly, to the persons so employed, or to the surrounding population; either by contaminating the air which they breathe, or more frequently the water which they drink.

The rapid increase of population, owing to an increasing birth-rate and an enormous immigration, must of necessity create a certain amount of crowding in our large cities, and by this means a lower sanitary condition is reached by all. Although such conditions of life are exceedingly hurtful to those who are the direct cause of this crowding, the evil effects are unfortunately not alone confined to so limited an area, and the neighboring population provided with much better sanitary measures and surroundings are made the victims of their fellow man's carelessness, poverty or filth. By the crowding of dwellings and mills along water-courses we have a ready source for the distribution of all the diseases whose lesions are situated in the gastro-intestinal tract, and also many of the diseases whose lesions are manifested in the kidneys. By this same increase in

population and manufactories the air is more contaminated than is healthful, by the breath of mankind and animals, the gases and smoke resulting from the combustion of large quantities of fuel for heating and for the production of motor power for manufacturing purposes. Thus it is clear that the increase of many of our ailments is due to the increase in the number and fertility of our "hotbeds" of disease. From this increase in number and fertility it is natural that certain diseases should increase in frequency and virulence, and by arising from such favorable soils for growth, it is but natural that some of their major as well as their minor characteristics should undergo a change to a greater or less extent.

While it cannot be denied that our increased civilization has cost us dearly by increasing our predisposing and exciting causes of disease, it is, nevertheless, equally true that this same civilization aids us in protecting ourselves against exposures and accidents which some years ago cost the lives of thousands. Many thousands of lives are annually saved, or prolonged, by various comforts, etc., which our less favored forefathers did not possess; and every day brings forth some new discovery whereby life may be saved or protected from unnecessary wear and tear.

Not only has the advance of civilization, by the increase in number of mills and population, brought about certain changes in our lives, but the NEW methods of manufacture, or completing other works which were not possible a few years ago, and which have since come into use, are many of them so inimical to health that *new* diseases have actually arisen; although, fortunately, their number is small in comparison with those forms of disease whose characteristics have been altered.

In this short and imperfect prelude we can perhaps see why we have "New and Altered Forms of Disease due to the Advance of Civilization in the Last Half Century."

Although the work and environments no doubt affect persons very greatly, it is certain that the air, water and food by means of which we live should be looked after more than everything else, if we desire health. Scientific investigators, differ as they may in

other matters, all agree in one thing at least, viz.—That pure air, pure water and pure food, are the greatest protection we have against every disease, whether the disease be limited to an individual or scattered abroad among thousands.

When our forefathers, as boys, arose shivering from their beds on a cold winter's morning, to dress in a room whose temperature was little above that of the outside air, it is probable that though they thought their fate hard, they felt all the better for the chill, which being followed by the reaction always present in a healthy system, sent the blood bounding to their finger tips and themselves down to their work with a vim and to their breakfasts with an appetite. If the average schoolboy of the present day be compared with the boy of fifty years ago, the change in his condition when rising and when at the breakfast table is marked. Instead of feeling alert and springy, he too often feels relaxed and languid, and his appetite has to be coaxed with dainties which are seldom wholesome. He seldom feels himself, until, by romping in the open air with his playfellows, he has inhaled enough fresh air to relieve his system of its burden of impurities obtained during the night. While many causes tend toward such a result the chief cause is the use of furnace-heated air in the sleeping room.

Into the vast majority of houses, especially in the cities, and largely in the country, during the past fifty years, the so-called "furnace" has been introduced. While these inventions have proved exceedingly useful in warming the air of rooms and other places where people congregate, they are singularly harmful in their methods of operation. So accustomed have most of us grown to this condition of things that we consider a house incomplete without a furnace in some part of it which heats at least the major portion of the house.

There are many ways of improving the operations of these furnaces, but even if all advantageous measures be resorted to, it is to be feared that there still remain certain faults which it is impossible to rectify.

In obtaining our supply of fresh air for the furnace one of

our chief aims should be to obtain it from a pure source. The air should therefore come direct from out of doors, and not be taken from the cellar, as is too often the case, since cellars are often damp and impure, from escaping gases, both from underground drains and gas pipes.

The shaft which runs from the furnace to the outside air should open externally in some quiet, protected spot where the air is not laden with dust, for it should never be forgotten that disease germs of all kinds are carried hither and thither by winds. Although *extreme* high heat is destructive to all such micro-organisms it is to be doubted if any dwelling-house furnace exists which heats its hot-air cylinders sufficiently to be germicidal in effect. Generally the heat is just sufficient to dry all floating particles and make them lighter and more readily diffused. So in cities we have the dust from dried-up gutters, which contain we know not what, drawn into our houses and dispersed into our rooms. Every one knows how quickly everything in a furnace-heated room becomes covered by a fine, impalpable dust, which seems to float everywhere. If this dust be driven into the room of a sleeper it enters his air passages and is caught on the moist mucous membrane, where the most favorable conditions for the growth of micro-organisms are present, namely, heat and moisture.

Evading the possibility of the presence of disease-germs, we cannot evade the fact that the air which is driven into the apartment has been deprived of its normal degree of humidity, and the moisture of the air already present is therefore reduced.

While no specific new disease is in this way engendered, all diseases of the air passages are increased in frequency and force. Every medical reader knows that a certain amount of moisture in the air of a room is a *sine qua non* for the successful treatment of bronchitis and pneumonia. In the Children's Hospitals of England, and somewhat less frequently in this country, the so-called "bronchitis-tent" is constantly used; more properly called a steam tent. By the passage of dry and dust-laden air over the mucous membranes in respiration they become dryer

than normal, and covered by a coating of minute foreign matter which is irritating in its effects.

By this means laryngitis and pharyngitis are frequently produced. Nasal inflammations are often caused, and otherwise mild attacks of respiratory disorders are intensified in violence.

The writer is one of those who firmly believe that frequently the predisposing causes of disease are greater factors in the production thereof than the exciting causes themselves, and that many very serious ailments can be warded off if a proper condition of the system can everywhere be kept up. In other words, a condition of standard vitality is essential to the welfare of every one. He believes in the theory of Lister when it asserts that disease-germs only find access to the system through depressed areas of vitality, and that the tendency of strictly normal tissues is to oppose their entrance. It is, therefore, of prime importance that every surface of the body, particularly in the respiratory and intestinal tracts, should be in a healthy condition. It is just this degree of health which furnace-heated air prevents, because it dries the respiratory mucous membranes, all the way from the lips to the most minute bronchioles, and by so doing inspissates their contents.

Further, the whole system of ventilation used by our forefathers is disturbed. Instead of the fireplace or stove, which ventilate the room by drawing out the stale air, and thereby causing an influx of fresh air, we have an arrangement by which air is *forced in* and *leaks out* as best it may; very frequently the stale air remains and the newly added air immediately escapes. Any one going into two rooms, the one of which is heated by an open fireplace, the other by means of a furnace, will notice the difference in the character of the atmosphere of the two apartments, the first being sweet and fresh and the second close and "stuffy."

Passing on to a brief consideration of the more pronounced and serious results of the inhalation of foreign bodies by artisans employed in handling dusty fabrics, or grinding and polishing metals or stones, we come upon a subject whose history extends

many years back of the time allotted to this essay. The discussion of the production of pneumonokoniosis and of the many forms in which this disease may be subdivided is, of course, out of place at this time. Yet certain new processes now employed in the arts have very considerably increased the number of exciting causes in this disease, and with the reader's permission, a short space will be devoted to a brief account of their origin.

It is hardly necessary to state that the condition known as anthracosis has been recognized as a cause of various respiratory disorders for many years, and that chalicosis shares with it the distinction of early recognition.

The conditions arising from the inhalation of fine particles of wool or cotton in manufacturing these articles for general use is of comparatively recent date, and the other substances which are set afloat in the air, other than cotton and wool, under such circumstances, often act as powerful allies to the organic matter present. Thus we find that in "sizing" cotton fabrics various clays are used, very frequently for the purpose of lessening the glutinous qualities of the flour or tallow, and although the process is usually carried on in damp rooms, a sufficient quantity of deleterious matter is put in motion through the air to expose the workman to no small degree of danger. In all towns and cities where large quantities of carpets are made, we find hundreds of cases of more or less severe disease arising from just these causes, and a friend of the writer, who has had charge of an exceedingly large dispensary service* in a situation the population of which consists almost entirely of mill hands, tells me that it is positively amazing the number of cases of chronic cough and phthisis which come to his notice, and in whose sputa he finds large quantities of wool and cotton fibre, the identity of which cannot be doubted since it often is stained the color of the dye used in the piece of fabric at which the artisan has been at work. An irritative cough is often seen in bakers who handle large quantities of highly-dried flour, used in making biscuits, and cases are numerous in which large quantities of the oxide of

* Over one hundred medical cases a day.

iron have been found in the lungs of persons who, during life, had been exposed to fine particles of iron dust.

While exposure to changes from heat to cold has from time immemorial been recognized as an exciting cause of disease, it is certainly true that more opportunities for such exposures are present now than there were some years ago, simply because the use of steam has become so widespread, and the corresponding use of fire has increased so greatly.

Within the last fifty years almost all steam appliances have been invented, or at least perfected, and as a consequence an exceedingly numerous body of men have arisen who earn their living by attending to these new forces of civilization, and who are, therefore, exposed to varying degrees of artificial heat. It is needless to say that these men suffer in direct proportion to the degree of heat by which they are surrounded, and by the frequency with which they are exposed to cold. The degree of cold is, of course, also a strong factor in the case. Many engineers and firemen have duties which take them frequently into the outside air, and firemen especially suffer, since their work is so much more closely connected with the fire.

Perhaps the best example which can be called to mind is that of the firemen on the large ocean steamships which ply between this country and Liverpool. Working, as these men do, in the hold of a ship and surrounded by fires on all sides,* the only ventilation coming from above, it cannot be wondered at that they strip to the waist and fairly drip with sweat, and when "relieved" go to the deck, there to get a "whiff of fresh air, and perhaps a fatal chilling of their bodies. The mortality among these men is frightful, and the writer has been informed by ship surgeons that few "stokers" live more than two years after entering upon their duties, provided they stay at work with fair regularity. That the "stokers" on these steamships are generally the most debauched set of men to be found, is, of course, to be taken into consideration when speaking of the high mortality among them, since their systems,

* The temperature of the atmosphere is often over 150° F.

owing to drink and dissipation, are in no condition to resist an attack of any one of the thousand and one diseases, particularly respiratory and renal, which are the result of what is familiarly called "taking cold."

The same exposure is suffered by the locomotive fireman, who stands one moment by the open door of a blazing fire and the next moment is shoveling coal or filling a tank in the "tender," when the temperature of the surrounding atmosphere is many degrees below zero.

It is not possible for a human being to be exposed to such sudden changes of temperature without suffering more or less acutely, either by a congestion of the lungs or by the production of diseased tendencies which only need an extra strain to break the man down for the rest of his life.

Heretofore, in considering this, the first division of this paper, we have only pointed out certain diseases whose forms were altered, but which were not of themselves *new*.

Just at this point, however, we come to the consideration of a disease which, of all others, belongs to a paper bearing the title which this one does, namely, "*The Caisson Disease.*"

Of all the diseases produced by the advancing strides of civilization this one is certainly the most interesting, not only because it has arisen so lately, comparatively speaking, but because of the discussion and doubt which it has given rise to.

Before going further it may be well to recall to the reader's mind the circumstances under which the disease originates.

The Caisson, as every one knows, varies greatly, according to the work which it is desired to perform, but it usually consists of a hollow iron or wooden chamber, which is heavily weighted on top in order to make it sink. The bottom is open while the top is air-tight, and in this respect it is identical with the diving bell. The entrance of water is prevented by the chamber being filled with air which is compressed to a greater or less degree, according to the depth of water in which the caisson is sunk,

and when the bottom of the stream is very far beneath the surface an atmospheric pressure of ninety pounds to the square inch is often required, and this is provided by engines which constantly renew the air for the benefit of the workmen.

Working under the heavy atmospheric pressure present in a caisson, in an atmosphere whose relative proportions of humidity and temperature are far from normal, and which is laden with the exhalations of men under the most severe toil, we cannot wonder that these men suffer from a variety of severe symptoms on regaining the outer air.

On emerging from a caisson whose atmospheric pressure is above normal, certain symptoms more or less severe assert themselves, which are in direct ratio with the degree of pressure. In the mildest cases nothing other than a feeling of dizziness and vertigo appears, which may be complicated by neuralgic pains in the head. If the pressure has been high or the individual susceptible, these neuralgic pains become most excruciating, darting with fearful velocity through the arms and legs, and head, and sometimes the trunk. So intense are they that that the sufferers say that "it seems as if the flesh were being stripped off their bones." Following these pains comes paralysis, in which sensation and motion are lost equally.

While the sensory nerves no longer convey to their respective centres the sensation of pressure or of pricking, there is no amelioration of the pains. In some cases nausea and vomiting come on, preceded by violent epigastric paroxysms of pain, and in other cases the vomiting is replaced by loss of power of the sphincters. This is particularly the case with the sphincter of the bladder, some observers asserting that in every case where paralysis is present the bladder is affected.

No regular course of symptoms can be laid down. In some cases the pains are absent while the paralysis is present, and when the exposure has not been severe the paralysis may not come on at all. It is safe to assert, however, that no case which has had a severe exposure ever escapes without the paralysis.

The symptoms come on, in certain cases, some time after the

return to the open air, and in others the instant the pressure is relieved.

Where coma follows the vertigo or paralysis, death is invariably the result, but the prognosis is generally favorable unless the other symptoms are unusually severe.

The most constant symptom of all is pain, from which few cases escape; even the vertigo, dizziness and double vision being secondary to it.

In some cases the paralysis is merely hinted at by weakness of the knees and slight loss of sensation.

The duration of the disease is as variable as its symptoms; the mildest cases rarely last over twelve hours, sometimes only three or four, but the paralysis may last from days to weeks without preventing a favorable prognosis.

Many theories have arisen as to the pathology of this highly interesting disease. As early as 1860, Francois advanced the theory that the phenomena might be due to the liberation, in the vessels, of air which had been taken up by the blood during the exposure to the highly compressed atmosphere of the caisson. Later than this he concluded that it was oxygen gas alone which caused the trouble. Following the propositions of Francois came those of Paul Bert and Hoppe-Seyler, who asserted very positively that the blood, when the body was in the compressed atmosphere, became loaded with nitrogen gas and not oxygen or air. Bert states that he has found bubbles of nitrogen in the blood vessels of the brain after death, and that he has seen the blood of dogs who had been under a high atmospheric pressure fairly foam with bubbles of nitrogen when caught in a dish, the normal pressure being present.

Hoppe-Seyler, who made several autopsies on men who had not survived the exposure, found the brain and spinal cord fissured and torn, and Bert also reports similar conditions in the cases in which he has performed the autopsy. Both Paul Bert and Hoppe-Seyler believe these fissures and rents to be due to a sudden release of the excess of nitrogen in the blood vessels, when the external pressure is removed; or, in other words, they

believe the abnormal conditions are brought about by a nitrogenous apoplexy, if such a term can be used. Dr. A. H. Smith, of New York, who has had a most extensive view of the disease, owing to the fact of his being the physician connected with the work on the great Brooklyn Bridge, on the other hand, believes that the symptoms are entirely the result of the changes produced in the circulation. In support of this belief he states that after death all the concomitants of intense internal congestion are present. The great vessels of the thorax and abdomen are found engorged and the blood vessels of the brain and spinal cord are also intensely congested. The liver and spleen are also full of blood, and Jaminet, with many other observers, asserts that he has found clots in the kidneys. Further than this the coats of the stomach are found to be red and ecchymosed, and the intestines and bladder share in like condition. Dr. Smith argues that these congestions are the result of the pressure exerted on the blood vessels supplying the periphery of the body while the person is in the caisson, and the consequent rush of displaced blood to those vessels which are protected from pressure by bony casements or tense and powerful muscles.

That this displacement of blood does really take place is proven by the pallor of the skin and superficial mucous membranes.*

All the blood which under ordinary circumstances is dis-

* Speaking of the effects of compressed air on the human organism, Oertel[1] says, "the vessels of the lungs and air passages, those of the oral and other mucous membranes which are directly exposed to the air, are most susceptible to this pressure and are least distended with blood as it forces its way on; whereas the vessels of those organs and tissues which lie in cavities with rigid walls, *e. g.*, in the cranial cavity, in the vertebral canal, and partly in the abdominal cavity, or in the bones, in the cartilaginous tissue, in the muscles and glands, of more resistant structure, which are but little if at all compressible by air pressure, their vessels become most full of blood, which gradually accumulates within them and distends them, and its fluid and constituent elements, if long detained there, transude in large quantities and give occasion to nutritive and functional changes."

[1] Handbook of General Therapeutics, Ziemssen; vol. iii. Respiratory Therapeutics, Oertel.

tributed to the superficial blood vessels is driven internally to those regions which escape the pressure. As a consequence the vessels of the bony casements, etc., become over-distended. This over-distention takes place, of course, while the individual is in the caisson, and the cardiac force being concentrated on a few vascular trunks is sufficient to drive the blood onward, through the vessels whose lumen is not affected by the pressure, even though their walls may aid the heart but slightly, owing to the paralysis resulting from stretching of their walls. Just so long as the person remains exposed to the compressed air he escapes serious consequences, since the vital nervous centres are kept supplied with sufficient blood for their proper nourishment. No sooner, however, does the man leave the caisson for the outside air, where the pressure is normal, than the force which has heretofore closed the peripheral and unprotected vessels is removed and every hungry artery and arteriole opens its mouth for a proper supply of blood. Into these open peripheral vessels the blood rushes, driven by two forces, one of which is the law that nature abhors a vacuum, and the other is the endeavor of the compressed blood in the blood vessels to escape to the surface where no such compression exists. As a consequence the vessels of the periphery are in their turn over-distended and the vessels of the brain and spinal cord are relaxed, by reason of their paralysis, and starved by having too little blood. They are deprived even of their usual quota by the superficial congestion. What little blood remains in the interior vessels stagnates, and pain and paralysis from nerve centre starvation present themselves.

The degree of peripheral displacement of blood has been closely studied by Junod, Sandahl, Petrequin and Ch. Pravaz, and many others, such as v. Vivenot, for example.*

The last named investigator found that when a rabbit was exposed to compressed air, the blood vessels of the external ear became diminished in calibre and much paler. The vessels of the conjunctiva and retina were decreased in size, and injected

* For references see Bibliography (p. 28).

areas due to conjunctivitis disappeared under the changed condition.

This contraction of abnormally distended vessels was also noted by nearly all the observers named, with others; thus Suchorsky and Kondratifew have observed, with the aid of a laryngoscope, that the injected blood vessels of laryngitis are not engorged when the patient is under the influence of compressed air. Panum remarks upon the loss of that feeling of pulsation so frequently accompanying severe toothache, and v. Vivenot mentions cases of erysipelas in which the heat, pain and swelling disappeared when under the influence of increased atmospheric pressure. Foley, too, speaks of a remarkable bleaching of the skin of workmen during a stay in a chamber the air of which was condensed to three and a half atmospheres.

On the larger peripheral vessels the effects of condensed air have been studied by Sandahl, Simonoff and v. Vivenot, and their results are entirely concordant. The radial pulse becomes smaller, slower, and under a pressure of two or three atmospheres thready and hardly perceptible.

This change in size is, of course, due to the pressure directly, but the slowing of pulse rate has given rise to considerable dispute.

The greatest change in rate was noted by Bertin who had one patient whose heart was slowed from thirty-six to thirty beats a minute, but this was an exceptional case, since in fifty-one experiments, made by Simonoff, he found that the pulse rate was decreased, after an exposure of twenty minutes, by four beats, after one hour and twenty minutes by eight beats, and after two hours by five beats, below the rate present under normal conditions.

It is now pretty generally admitted that this slowing of pulse rate is due to the blocking up, by the pressure, of the peripheral vessels in such a way that the heart has difficulty in driving blood out of itself, and Marey has proved that the heart beats more rapidly the more easily it can empty itself.

When the atmospheric pressure is very high even the radial

pulse is lost, and, in Waldenburg's experiments, the "pelotte" had to be screwed down 1.36 of a millimetre before pulsation returned. Both Liebig and Bert have proved positively that the absorption of oxygen in compressed air is increased. Thus Liebig found that there was an increase of eleven per cent. in the amount of oxygen absorbed under pressure, and that this amount was increased by hard work. Bert did not find such a decided increase, by any means, and found that the number of respirations had no effect on the amount of oxygen absorbed.

The conclusions of Bert are that the excretion of carbonic acid is not affected by high atmospheric pressure, while Liebig believes it to be very slightly less when under pressure than it is when under normal conditions. Liebig believes this slight decrease to be due not to an actual diminution of the carbonic acid, but to increased absorption of oxygen. The question naturally arises, does this increase in the absorption of oxygen produce any increase in the bodily temperature while in the compressed air.

Experiments to determine this point have been performed by Vivenot and Stembo, but their results are opposed to each other. Vivenot found that there was rise of temperature which was not proportionate to the time spent in the compressed air. Thus, at first, the temperature rose 0.503° C., then fell to 0.344° C., then again fell to 0.212° C.; or, in other words, the temperature at the end of the experiment was only increased 0.212° C. over the normal temperature, before the chamber was entered. Vivenot attributed this increased bodily heat not only to increased oxidation, but also to the fact that the dissipation of bodily heat was necessarily diminished, owing to the bloodless condition of the surface, thereby preventing the radiation of heat to the surrounding atmosphere. The evaporation of water from the surface being lessened also prevents any cooling of the body by this medium. On the other hand the experiments of Stembo show that the production of bodily heat is lessened, and he attributes the variance of results between his experiments and Vivenot's to the fact that the

thermometer was not left long enough in the axilla in the latter's work, and that, therefore, fallacious results were reached.

Both of the methods employed by these investigators were so crude that it can hardly be wondered at that their results differed. The only true way to obtain results of absolute worth would be by the use of the calorimeter, used nowadays in all work in which the question of heat production and heat dissipation is to be elucidated. It seems probable, therefore, that while the results so far obtained are contradictory and open to serious error, the results of Vivenot are the more nearly correct, since other observers have also noted an increase of bodily heat production; and as the increased absorption of oxygen would naturally bring about increased heat generation coupled with the difficulty present in regard to heat dissipation, already mentioned, we have theoretical and partial practical proof of the correctness of the last named observer's conclusions.

It should have been mentioned that Simonoff and Sandahl have proved that there is a distinct loss of bodily weight while men are in a caisson. This loss was not very much greater than is normal when men are at hard work, unless the quantity of food was small. While the difference in loss of weight while under toil in and out of the caisson was not sufficient to allow these observers to safely draw any conclusions therefrom, it rather points toward the support of the theory of Vivenot, mentioned above.

If Vivenot's theory be a correct one, and if Liebig's and Bert's theories in regard to the increased absorption of oxygen are correct, then we can readily account for a decrease in weight while in the caisson, by means of rapid tissue waste. Although in Simonoff's and Sandahl's experiments the decrease in bodily weight was but slightly increased when in the caisson over the weight lost in the same labor under normal pressure, it should not be forgotten that the loss of weight in men under ordinary pressure is due to two factors, viz., the throwing off of fluid by the lungs and skin and oxidation or tissue waste.

Now it has already been shown in this paper that very little

evaporation of the body fluids can take place when the skin and lung surfaces are blanched and partially bloodless, and it seems, therefore, probable, if not positively the truth, that the reduction of weight in the caisson is entirely due to tissue change, and that scarcely any weight is lost through the dissipation of liquids from the surface of the body. This does not seem to have been taken into account in the conclusions of the experimenters named, but to the writer's mind it is an exceedingly important factor, since such a condition of things shows that the loss of bodily weight by simple oxidation was in excess of the normal loss, even when that normal loss was aided by the evaporation of the fluids of the body.*

Closely associated with the subject of increased oxidation and decrease of bodily weight, is the question as to the amount of urea which is eliminated by persons under atmospheric pressure of any degree above the normal.

Hadra has decided beyond cavil that the amount of the urea is increased, but as he does not regard the oxidation theory as absolutely proven, he declines to decide whether the increase in urea is due to increased combustion of albumen in the body, or to other causes.

It would be unjust to the subject before us not to state that more recently A. Fränkel has failed to discover any increase in the amount of urea in the urine of a dog which he exposed to a pressure of two atmospheres for a great length of time. As the experiments of Hadra were made on man, it may be that the difference in results was due to the partaking of more albuminous food by the individual than was taken proportionately by the dog. Then, too, it should always be remembered that the comparative estimation of urea under any circumstances is open to serious errors, which it is almost impossible to avoid, since any slight increase of muscular action immediately nullifies all results.

The researches of Dr. Jaminet during the building of the St.

* That increased oxidation does take place is proven clinically by the fact that the appetite of a person exposed to high pressure rapidly increases, and that when no extra food is taken there is progressive loss of weight.

Louis Bridge throw much light on the results of both Hadra and Fränkel. This experimenter, whose experience was very great, found that when the atmospheric pressure was increased to four and one half times the normal, the amount of oxygen taken into the system was also increased four and one-half times, and he argued from this that the tissue waste was increased in the same ratio. Careful examination also showed him that the quantity of urine was increased, and that the increased amount of urea present exceeded proportionately the amount present under normal conditions.

Returning again to the opinions and theories of various writers on the subject, as to the cause of the symptoms, we find that almost every writer has a theory which is partially or entirely different from his predecessors.

Dr. Jaminet believed the symptoms to be due to the overloading of the system with effete matter during the stay in the caisson, the symptoms being held in abeyance during this time by the excess of oxygen inhaled and coming forward in full force the moment the excess of oxygen was removed by returning to the open air.

Dr. Bauer, of St. Louis, suggests that the symptoms may be due to hyperoxygenation of the blood and a consequent rapid waste of organic tissue, by which means the blood becomes loaded with effete matter and carbonic acid gas.* He believes that as long as this hyperoxygenation takes place the man escapes, but that a return to the open air, where he obtains less oxygen, prevents the system from ridding itself of the poisonous matter, and the usual phenomena are produced. Prof. Woodward, who has written a history of the building of the St. Louis bridge, believes that the symptoms are due to the abstraction of heat.

Returning one moment to the theory of Francois and Bert: Every one knows that when air is injected into the circulation of an animal, convulsions occur, which are due to emboli in the minute vessels of the brain, and that death results from a

* *St. Louis Med. and Surg. Jour.*, new series, vol. vii, pp. 234–245.

plugging up of the coronary arteries of the heart, unless the air is diffused by the lung surface ere it can have an opportunity of doing harm. If then, the theories of Francois and Bert are correct, we would expect to find an enormous mortality among those who were attacked by the disease, whereas this is not the case by any means, for we find that out of *one hundred and nineteen* men attacked during the building of the St. Louis bridge only "fourteen died, and two were crippled," the remainder making perfect recoveries. At the Brooklyn Bridge only three men out of sixty-four who were attacked, died.

Then, too, if these theories are true, all men should be equally affected, since idiosyncrasy could hardly govern the absorption of air or gases by the blood. Further than this, it seems probable that the symptoms must come on immediately after leaving the caisson, as the air or gas would hardly lie dormant for any length of time after the external pressure was removed, and could hardly escape diffusion, at least in part, while passing through the lungs.

The following quotation * illustrates, very clearly, that the natural tendency of gases in the blood is to become diffused through the lungs under circumstances similar to those which we are considering. "The effect produced by diminution of the pressure on the surface of the body is to facilitate and amplify the inspiratory act and increase inspiratory dilatation of the lungs." Further, "not only is traction exercised upon the external surface of the thorax, which, if it still possesses sufficient mobility, strives to meet it, and thereby assists the action of the inspiratory muscles in inspiration; but the pulmonary air also, now standing under higher tension, will tend to expand as compressed air does after its inspiration, and exercise pressure outward."

While the words just quoted are used in connection with a consideration of the effects produced by placing the body in an atmosphere which is rarefied, it will be seen that the same change

* Ziemssen's Handbook of General Therapeutics, Vol. III—"Respiratory Therapeutics," page 594—Article by Oertel.

in surrounding conditions takes place when the workman leaves the high pressure of a caisson for the normal air; since it makes little difference, except in degree, whether a man passes from a pressure of fifteen pounds to the square inch to a lower one, or whether he passes from the high pressure of a caisson to the lower pressure of the normal air. Coupling these facts with the fact that eating a meal before entering the caisson is a strong prophylactic against an attack, I think we may fairly conclude that the theories of Francois and Paul Bert do not hold good, except in certain instances where the atmospheric pressure has been enormously high, and where death has occurred almost instantly on leaving the caisson. In the experiments of Bert on dogs, the pressure amounted to 6 or 7 atmospheres, and he himself states that he has never found bubbles of nitrogen in the vessels unless the pressure had been as high as 5 or 6 atmospheres, while Smith reports cases occurring after an exposure to only two atmospheres.

Again, we find that men become habituated to the exposure, and that certain types of mankind are much more prone to the disease than others, which cannot be accounted for if Bert's theory is accepted, as it is hard to imagine how any person could become accustomed to the formation of cerebral or coronary emboli.

Thus, Smith found that of thirty-nine men with a tendency to corpulency, only three escaped illness, while of fifty-three lean and lank men, twenty-five escaped. Of the thirty-nine stout men, eight were more or less paralyzed; of the fifty-three slender men only two were paralyzed. The deaths, three in number, were all among stout men.

While the theories of Woodward, of Bauer and of Jaminet are all doubtless worthy of a place in the causation of all cases, mild or otherwise, of this disease, to the writer's mind, the arguments of Smith are the most convincing and the least contradictory, since by this means we can explain the habituation to exposure which is known to take place among men who earn their livelihood in this way; for we can readily understand that the vasomotor system might gradually become accustomed to the

changes and prevent serious consequences by overcoming distention, etc., etc.

Dr. Smith explains the susceptibility of stout men in the following manner: In the stout man there is a greater external surface and more fluids in the body than there is in lean men, and therefore sudden changes from high to low pressure create much greater systemic disturbances than they otherwise would. As the treatment of the affection is closely associated with the conditions believed to be present, and as some of the results of treatment appear to strengthen the opinion of Dr. Smith, the writer will be excused if, for a moment, he digresses from the strict meaning and aim of the paper, and describes the methods of relieving those who may be suffering from this extremely painful malady.

All observers of this disease insist very strongly on the partaking of food previous to entering the caisson, as a prophylactic measure, and Jaminet took especial care that every man should have had a full meal within an hour of his entering the caisson, and a cup of beef-tea a moment before doing so. The use of alcohol in any form is strictly forbidden and persons who are addicted to its use invariably suffer from the disease.

One of the best prophylactic measures, now instituted by every careful superintendent of such work, is the arrangement of several chambers, each one of which contains an atmosphere of a less degree of pressure than its predecessor. In this way the workmen experiences a gradual change from the high pressure to the normal, and is not exposed to any sudden change. Another important measure is the provision of some means by which the men may be brought up to the surface without much muscular effort on their part. This was well illustrated in the St. Louis Bridge. In building the east pier, thirteen of the men employed died; but in building the east abutment,* which was sunk five feet deeper than the east pier, only one man died. The causes of this change in mortality lies in the fact that in the

* This abutment was sunk one hundred and twenty-seven feet below high water mark.

east pier the men had to climb about one hundred and ninety steps upward after leaving the caisson, while in the east abutment a steam elevator was provided to raise the men to the surface. As regards the direct treatment of the disease, the pains are the first thing that call for attention. Morphia should be given hypodermically in large doses, and when for any reason this drug cannot be given, atropia may be substituted, although not nearly as serviceable.

Acting on the theory that the pains were due to vascular relaxation, Dr. Smith argued that large doses of ergot would be of value, and practical tests proved the correctness of his opinion, at least in a large majority of cases. Hard rubbing with the bare hand is also of benefit, as tending to aid the circulation. Cloths wet with hot water should be wrung out and applied to the feet while cold is applied to the spine and head. In cases of great pain over the epigastrium, Jaminet recommends most strongly a strong alcholic stimulant with ginger. The whole aim of the attendant is to restore the circulation to its normal status, and to relieving congestions and impoverished nerve centres. When paralysis comes on cups should be applied to the back of the neck and along the spine, alternate dashes of hot and cold water on the back and chest, and all the measures used which we know further the circulation of the blood.

If the paralysis remains for any length of time, electricity and strychnia may be used. When the dizziness and headache is an annoying symptom, cold should be applied to the head and warmth to the feet.

As in every case of paralysis, the bladder should be carefully watched and relieved of its contents regularly, by the use of the catheter, unless the urine is passed freely and without retention.

When headache and paralysis seem to be the forerunners of coma the most vehement measures should be adopted, and all of the methods usually applicable to cases of threatened coma from like causes are equally useful here.

If the pulse be strong, full and bounding, venesection may be practiced unsparingly.

Experiment and practical experience has proved that relief is often obtainable in cases of this disease by returning the sufferer to the caisson, but as this is often impracticable, owing to the interference which it necessarily causes in the work, it has been proposed that an artificial caisson be built above ground, into which a patient can be brought, and out of which the compressed air can be very slowly allowed to escape. This idea has been found of great practical utility in the few instances in which it has been put into operation.

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PHOSPHOR-NECROSIS.

Like caisson disease, Phosphor-necrosis is a subject which should occupy a prominent place in this paper, both because of its frequency among a certain class of artisans, and as showing the importance of an industry which has arisen and grown to enormous proportions within the last fifty years.

The first complete description of this malady was given us by Lorinser, who published an account of certain cases which he had seen, in 1839, just six years after lucifer matches began to be made on a large scale.

Following this observer came Dr. Wilks, of London, Heyfelder, of Erlangen, and Strohl, of Strasburg, all of whom described the disease in 1846. Next we find the exhaustive and

valuable paper of Von Bibra and Geist, of Nuremburg, which is, after all, the only truly original essay, from which we can form correct conclusions as to the mode of development of this curious affection.

Following the studies of the experimenters just named, which were made in 1847, came the clinical lecture of Mr. John Simon on two cases which were under treatment at that time in St. Thomas' Hospital (1850).

Reports of this affection now became more frequent, and therefore lacking somewhat in the important bearing of their predecessors, although the report of a case by Dr. James R. Wood, of New York, in 1856, is of particular interest, owing to the fact that it was the first case recorded by an American, and also owing to the severity and rare seat of the disease in the particular case under his care.

Other American surgeons soon after described the affection, many of the cases reported by them being types of a severe form of the disease. Prominent among these are the reports of Drs. Hunt and Boker, of Philadelphia, and Dr. J. C. Hutchinson, of Brooklyn. Salter and Bristowe, in England, also reported cases, and in 1867, Sir Christopher Heath obtained the Jacksonian Prize of the Royal College of Surgeons, for an essay on diseases of the jaws, including Phosphor–necrosis.*

At present nearly all large text-books on Surgery give reasonably full descriptions of the disease.† Within the last few months quite an elaborate paper on the subject has been prepared by Dr. J. Ewing Mears,‡ whose experience has been quite large among those who are employed in match manufactories.

The experiments of von Bibra and Geist are, as before stated, the only reliable ones whose record we possess, and the conclu-

* See Jacksonian Prize Essay, 1867; also see p. 530, vol. v, International Encyclopædia of Surgery.

† See works of Agnew and S. D. Gross.

‡ Read at the annual meeting of the American Surgical Association, 1885. See *Philadelphia Medical Times*, January 9, 1886.

sions which they reached have been, and are still, largely believed in by a majority of the profession.

In an extended series of experiments these observers found that the disease of the maxillæ was produced not by the solid phosphorus itself, but by the fumes of phosphorus, and these conclusions were founded on the fact that the constant application of solid phosphorus to an exposed jawbone failed to produce any lesion; whereas the jawbone of rabbits who were exposed to the *fumes* of phosphorus in an enclosed chamber invariably became necrosed, provided, that the fumes were permitted to come fairly in contact with the bone itself, or with its periosteum. Prolonged exposure to phosphorus fumes while the jaw was protected by its natural covering failed, invariably, to produce any lesion unless the animals possessed carious teeth, in which case the disease always originated at the base of the tooth whose continuity of substance was imperfect.* Wegner confirmed these results; he also administered, for a long period of time, large doses of phosphorus to rabbits, without producing any sign of the disease.

While Langenbach and Lorinser believed the caries to be due to constitutional disorder, the observers already mentioned, with one exception, have all very strenuously insisted that the trouble was entirely local in character. Dr. Mears (*loc. cit.*) agrees with the earliest reporters in this matter, and brings forward certain evidence, which, while it is not by any means conclusive, shows that he has good ground for his belief. This last observer thinks that the whole system of a match-maker who has been exposed to the fumes of phosphorus is depressed and ready to partake instantly in any local inflammation which may be started by the taking of a little "cold" or irritating, in any way, an already inflamed surface. Thus he states that in all the cases he has examined he has found large quantities of tartar adherent to the teeth at the margin of the alveolus, and that the gum has in nearly all cases been retracted, thereby leaving the neck of the tooth and the edge of the alveolus exposed. It is in this already

* See *Virchow's Archiv*, June 22, 1872.

denuded surface that he believes the systemic disturbances assert themselves, or in other words that, the system being depressed, the disease begins, not by the direct exposure of the surface to new fumes, but by the morbid systemic condition already at hand.

While we find scarcely any notice whatever taken of any constitutional effects produced by exposure to the fumes of phosphorus in the reports of other writers, Dr. Mears states that in all the cases he has seen, constitutional and marked systemic symptoms have presented themselves long before the disease has manifested itself in the lower or upper jaw.

According to his cases conjunctivitis and bronchial irritation have been the chief symptoms showing any involvement of the mucous membranes. Constipation has been a more frequent symptom than diarrhœa, and he failed to find any aphrodisiac effects, either in the male or female employés. In the females no appreciable increase in the menstrual flow took place. The most troublesome toxic symptom was the occurrence of hemorrhages from the gums, and this condition was by no means infrequent.

Careful inquiry among the artisans thus employed brought out the history of pain over the hypochondriac region, sick headache, nausea, and muscular debility. Dr. Mears' explanation of the hemorrhagic effusions about the gums is best given in his own words. "Accepting as parts of the pathological processes which follow toxic effects, disintegration of the red blood corpuscles and fatty degeneration of the arterial walls, we find in the highly vascular periosteum a membrane most liable to exhibit the effects of these morbid changes. Owing to the weakened condition of the arterial walls consequent upon the state of fatty degeneration present, the vascular tension is wholly or in great part lost, and the tissue, while surcharged with blood, is in a state of innutrition, owing to the impoverished condition of the blood, so that I have observed free hemorrhage taking place from gums blanched and apparently bloodless."

In summing up the whole evidence in regard to the matter,

the writer is forced to believe in the doctrine that the disease is due, not to constitutional effects, but to a direct action of the fumes on the jaw itself, when exposed to the air by some solution of continuity. It should here be stated, in justice to the theory of Dr. Mears, that he has himself seen cases in which caries of the teeth has been present for a very great length of time without the jaw becoming implicated; but while this is one of the strongest points in the evidence supporting his views, it is by no means strong enough to overthrow the opinions of many others whose experience has been equally wide, or the results obtained by the use of animals, as in the experiments of Wegner and those of Von Bibra and Geist. Further than this, it has been directly proved that the disease will originate in any bone whose surface or periosteum is exposed, and that it *never occurs* in any long bone in the body unless that bone has had its covering of skin and muscle removed by some traumatism or the knife. This fact certainly proves the local origin of the disease, for if it resulted from constitutional poisoning why should the jawbone be the favorite seat for necrosis.

While the writer believes, then, in the local origin theory, he would not have it understood that he thinks the constitutional disturbances have no effect on the production or cause of the malady, since every one knows that systemic depression is the best adjuvant to local morbid changes.

The fumes attack the jaw in two ways; first, through the periosteum, and second, through the cancellated tissue, to which it gains access through the lining of the alveolus under the carious tooth. By this double method of attack the disease is very rapid in its development and course. When the lower jaw is affected, the rami are seldom involved, though cases are on record where even these portions of the bone did not escape.

The symptoms are always severe. At first the patient complains of a dull, aching pain, sometimes neuralgic in character, near the root of a decayed tooth, and the sufferer generally regards it as an ordinary toothache. Sometimes the first symptom which presents itself is a feeling as if the teeth were

being shoved out of their sockets, or that they had increased in length.

On examining the gums they are found to be spongy and softened, and pressure on the teeth elicits pain. If the disease involves the rami the pain extends to the ears and becomes absolutely unbearable. As the disease progresses the pain, which has been remittent, or even intermittent, becomes continuous and much increased in intensity, so severe as to cause loss of strength from lack of sleep and nervous strain; a small sore now appears on the gum above the diseased bone and soon implicates the mucous membrane of the cheek. The gums are not only soft and spongy, but possess a peculiar leaden hue. Swelling of the cheek now comes on and in a short time increases so greatly as to change the sufferer's whole appearance. Following this comes suppuration, and the pus and saliva burrow along the bone under the periosteum, or dribble from the mouth, making the breath of the patient overpowering in offensiveness. By this means separation of the periosteum from the bone takes place and new areas are deprived of blood and join in the general death. Long, fistulous tracts are formed in the cheek and cervical tissues. The general nutrition of the patient is still further interfered with at this time by the difficulty experienced in getting the jaw separated from its fellow, owing to the exudation, swelling and consequent fixation, thereby preventing the taking of solid food. The constant presence in the mouth of pus and foul saliva, which is unavoidably swallowed, increases the trouble by interfering with digestion. When the suppuration has been sufficiently prolonged, the bone becomes uncovered and appears of a dark gray color, having a worm-eaten surface. A large fibrinous exudate takes place about the lower border of the bone, assuming that the lower jaw is the one attacked, and this transudation is our chief aid in securing a favorable termination of the disease. If the malady has been particularly severe and rapid there comes on, after the pain and suppuration takes place, rigors, sweatings, fevers, nausea and vomiting, diarrhœa, and, if the patient survives long enough, pyæmia followed by death.

By far the most interesting and peculiar point in relation to the disease before us is its invariable appearance in one of the two maxillæ.

The statistics of this disease also show that the lower jaw is much more frequently affected than is the upper. In an analysis of 110 cases by Dr. Agnew, 58 cases occurred in the lower jaw and 41 cases in the upper jaw. Twelve cases occurred in both jaws. In the experience of Dr. Mears, out of 16 cases, 11 occurred in the lower jaw, 5 in the upper jaw, 3 in both jaws. Mr. Salter * records 5 cases occurring in his practice, in 4 of which the lower jaw was necrosed, and finally Heath records 52 cases, 21 of which were in the superior maxilla, 25 in the inferior maxilla and 5 in both maxillæ. Salter also collected 17 cases of the disease from other sources than his own practice, 9 of which occurred in the upper jaw and 8 in the lower jaw.

Considerable discussion has arisen as to the cause of the frequent occurrence of the disease in the lower jaw, and without detaining the reader with a long consideration of the pros and cons arraigned on each side of the question, the writer will briefly give the conclusions which have been reached by those best qualified to judge. The chief and probably the most positive factor in the protection of the superior maxilla, is its bony formation and its large vascular supply. Mr. Heath believes that necrosis occurs less frequently in cancellous tissue, than in compact tissue; but the experience of many of our surgeons is so directly opposed to this assertion, that we are at least safe in believing that the compact bony formation of the superior jaw is an aid to its repelling the advances of phosphor-necrosis. Certainly, it seems most natural that a disease should spread more rapidly through spongy tissue than compact tissue, and this belief is strengthened by the fact that while all parts of the lower jaw, except the lower edge, which is of compact bone, are affected, it is only the edges of the alveoli in the upper jaw which become diseased.

Unfortunately, there has arisen some difference of opinion as to the manner in which this remarkable disease is to be dealt

* Holmes Surgery, Vol. IV.

with. In this, as in every artisan's disease, preventive treatment is of quite as much importance as the treatment of the morbid process when once established, and the measures looking to this end will, therefore, be enumerated at once.

Of course, thorough ventilation is a *sine qua non*, and if it were possible, it can hardly be doubted but that every company manufacturing matches would have "air fans" continually at work to scatter and dilute the fumes. It would appear, however, that currents of air would aid in the production of disastrous conflagrations to such an extent as to preclude any such endeavor, at any rate, in certain rooms where the matches are much handled and constantly igniting. In one particular factory suction pipes have been arranged so that each one opens over a dipping machine, thus preventing the fumes from escaping into the surrounding atmosphere. Next to ventilation comes cleanliness about the mouth and strict care of the teeth, so that no cavities remain uncared for and no tartar is allowed to collect.

Other measures to be undertaken by the employé have been proposed, chief and best among which seems to be that of an "alkaline respirator," introduced by Mr. Graham, of England, and recommended by Prof. Agnew in his work on surgery.* This device consists in quilting equal parts of unslacked lime and sulphate of soda between two layers of porous cloth, which is bound over the mouth and nostrils while at work. Dr. J. Ewing Mears,† on the other hand, regards the use of turpentine as the best preventive measure we have, and believes its antidotal powers have been established. He recommends that the employés shall wear open, wide-mouthed bottles on their chests, affording in this way inhalation of the turpentine vapor, which he regards as a neutralizing agent to the phosphorus fumes. He also states that this is done quite commonly in Europe and England. Further, he suggests that large shallow pans of turpentine be placed in the workshops, so as to neutralize any fumes in the room. There is, however, very strong evidence that Dr.

* Vol. ii. † *Loc cit.*

Mears is mistaken as to the antidotal powers of turpentine, at least, in cases occurring in this country, for Dr. H. C. Wood * states that many experiments have been performed with this drug with contradictory results, and goes on to state that these differences of opinion arose from the use of different varieties of oil. There are three varieties of turpentine in European commerce—the rectified, the German and the French. Jonas, quoted by Wood, found that while the pure oil has no effect upon phosphorus, the acid French oil forms with it a crystalline, spermaceti-like mass. This is soluble in ether, alcohol and alkaline solutions, and is called turpentine-phosphoric acid. This compound is eliminated by the kidneys.

Wood also quotes the experiments of Vetter on dogs and rabbits, the results of which agreed with those of Jonas. The latter investigator found that the rectified and German oils have no value, and that the crude French acid oil is distinctly antidotal.

Kochler, however, asserts that German oil which has not been rectified for some time possesses antidotal powers, and believes the drug to act partly by oxidizing the poison, and partly by converting it into turpentine-phosphorous acid. According to Wood, the American oil of turpentine and Canada balsam are absolutely powerless.

Passing on to the consideration of the disease when once established, we find less division of opinion has arisen, and Dr. Mears divides this portion of the care of the case into three periods: primary, intermediate and secondary.

During the primary stage, when the earlier symptoms are presenting themselves, the teeth should be attended to and the soft structures bathed with tonic lotions, such as tincture of myrrh or any tonic-astringent mouth-wash. Discontinuance of work at this trade should be temporarily enforced and measures directed to the building up of the general bodily health be carried out.

In the intermediate stage, our endeavors must be turned to

* Therapeutics, Mat. Med. and Toxicology, 6th ed., p. 120.

allaying as far as possible the inflammatory conditions present, both by the use of the knife and internal medication. Later on, when, in the secondary stage, the bone is thoroughly diseased, nothing but operative interference is of service, and for these latter the writer must refer the reader to the standard works on surgery.

TELEGRAPHERS' CRAMP.

Since the use of electricity has become so general for the purposes of telegraphing, the disease known as "Telegraphers' Cramp" has become very prevalent among that class of operatives who are employed in large offices where many messages are daily sent off and received. Some discussion has arisen as to whether the several symptoms which the disease presents are each in their turn an indication of a more advanced stage in the disorder or are merely more prominent in one case than another by chance or tendency on the part of the individual to any one of them. Thus, some observers have held that the first sign of the disorder was the feeling of distress or fatigue in the overworked extremity, and that the tremors which sometimes occur were the symptoms which came on, provided the warning given by the fatigue was not heeded, and that disregard of this second symptom brought about the spasm or cramp, or, in other cases, the palsy. Other writers, especially those of the present day, attempted to prove that there is no distinct onward march of the symptoms from fatigue to tremor and from tremor to palsy or cramp, but rather that the disorder is to be divided into four varieties, each one of which may assert itself without the presence of a second.

Thus, Lewis* tells us that in some cases cramps come on, in others palsy, and in others tremors, while still another variety is separated from its fellows by the predominance of certain symptoms associated with disturbances of sensation. He states, however, that the disorder of sensation is always present in all forms of the trouble in some degree, and that it is only in cases where the trouble consists in a neuritis that the symptom rises to the

* Amer. Sys. Practical Med., Vol. v, p. 517.

importance of marking a separate variety. Briefly stated, the disease is in no way different in its causes and effects from the well-known Scriveners' and Hammerers' Cramp and Palsy of older origin, since excessive over-strain of certain muscles in performing daily duties brings each artisan so placed into the toils of the affection.

Leaving for one moment the etiology and pathology of these affections, and turning to the symptoms of telegraphers' cramp and palsy, we find that the patient first experiences for some days a feeling of stiffness and lack of pliability in his fingers, which is generally accompanied by a certain lack of coördination in the movements required. This inability to move the fingers rapidly and accurately is only present when the sufferer attempts to perform the movements which are the cause of the trouble, and almost all other motions, such as writing, etc., can be gone through with without difficulty. If the patient now insists on keeping on with his duties, the stiffness is replaced by violent cramps, more or less painful, which come on suddenly and with considerable power. Coördination is still further disordered, and all attempts at a repetition of the offending act are resented by the affected centres and muscles in such a positive manner as to make all movements irregular and often jerking in character. Unless absolute rest and avoidance of former movements is permitted, the cramps, etc., are followed by loss of power deepening into paralysis more or less complete. Even when paralysis exists, however, it is surprising to see how many *un*offending movements can be performed without discomfort and failure.

Many very prominent writers, on Scriveners' and Hammerers' palsy, assert that predisposition is one of the prime factors in the causation of these maladies. While this is doubtless true, to a certain extent, it is nevertheless true that all kinds of persons, be their temperaments nervous or otherwise, are affected, and in view of this fact the writer thinks that predisposition should not be accorded the leading position in the causation of the malady. It is, of course, probable that persons whose temperaments are nervous and excitable are naturally exposed to

nervous disorders, while the phlegmatic temperament is rather opposed to the conditions which are necessary for the presence of this disease.

Turning our attention to the cause of this train of symptoms we find that the constant and rapid motions required produces a species of both muscle and nerve-centre disorder. By the constant exercise of these muscles their nutrition is seriously interfered with, the exhaustion of muscle-fibre being greater than the replacement of the same. Exhaustion also acts on the nerve centres and loss of coördination and power result. Preceding the stage of exhaustion comes, however, a stage of excitement, such as is often seen in nerve centres whose balance has been overturned by some excessive discharge of force, and the result of this is the loss of balance, the cramp and the spasm of the fingers. The stage of exhaustion now follows, because the over-strain and over-excitability have swept away the few remaining cells which remained in the centre unused.

Rosenthal calls attention to the fact that the loss of power is limited entirely to those centres which are the directors of the particular muscles involved, and states in substantiation of this assertion that the surrounding centres for other groups of muscles always escape, as is proved by the fact already mentioned, that other acts can be performed without difficulty. While it is true that the surrounding centres are not affected, it is also true that the centre governing like movements in the opposite hand is, by sympathy or other cause, affected with its fellow to a certain extent. This is proved by the fact that if the operator learns to send messages with his well hand, that hand very soon follows the fate of its fellow.

The experiments which have recently been performed by Dr. Randolph, of the University of Pennsylvania, bear so strongly on the subject before us that the writer feels confident that they will interest the reader of this paper. His object was to discover if exhaustion of one centre in the brain produced any effect on the corresponding centre on the opposite side of the brain; and to this end he proceeded as follows: He procured a

gas metre, to which he attached a small lever. Resting the hand of the subject on the table, as when writing, he directed him to place the tip of his forefinger on the end of the lever and to depress it as often as he could. Each depression was, of course, registered in this way. Dr. Randolph found that if the right forefinger was used first it became exhausted at 100 movements, and that if the left forefinger was used first it became exhausted at 75 movements, 'provided the man was right-handed. The reason that the left hand could not make as many movements was simply the disability which always exists in right-handed persons. To put it briefly, Dr. Randolph found that, normally, the right forefinger possessed power for 100 movements, the left forefinger for 75 movements. Having decided this primary point he proceeded to search after the main object of his examination. He now found that if the left forefinger was set to work after the right forefinger had performed its 100 depressions, it became exhausted at 50 movements, and that if the right hand was set to work after the left forefinger had moved 75 times, it could only move 75 times. In other words, exhaustion of one forefinger deprived the other forefinger of the power for 25 movements, and proved that, in some way, exhaustion of one centre produced exhaustion of the corresponding centre on the opposite side of the brain. No examination of the brain and spinal cord have ever been made in cases of this disease, and our pathological knowledge must be based upon the symptoms, rather than on microscopical examination. This being the case, it is small wonder that many varied and ingenious theories have been advanced by different writers.

Electrical tests prove, however, that in most instances exaggerated reflexes are present denoting a super-excitability of the spinal cord, and in other cases evidences of neuritis of the nerve trunks have undoubtedly been observed. In some cases of the disease a species of pseudo-muscular hypertrophy comes on, due, probably, to some centric nervous lesion, and, perhaps, in part to the congested condition which is nearly always present in the affected muscles. Thus we find the bellies of the muscles hard,

firm and projecting, yet devoid of power. So many causes may enter into the production of the symptoms that speculation is almost boundless, since the varied conditions may be brought about from a direct action on the muscle or its nerve plates, the nerve trunk or its centres, or finally, there may be a generally disordered condition of the nervous and muscular portion, the extremity, in a single case. Leaving, therefore, the discussion of the pathology of this disorder, let us turn to its treatment. Of course, *rest* is the best measure that we possess for the cure of the affection; but although absolute rest from the exciting cause is one of the essential factors for a complete recovery, the affected arm should be used in every other motion which is natural and easy, so that it may not become useless from disuse. Next to rest we have as a therapeutic agent electricity, which is, however, only indicated in those cases where very slight or no inflammatory condition is present, either in the muscle, nerve, or nerve centre; and it should be the invariable rule to use that current which causes the most contraction with the least pain. Galvanization of the affected muscles should be performed in such a way that the disordered nerve centres are not disturbed, and care should be taken to gradually increase the exercise, so as not to exhaust or over-fatigue the muscles which are out of order.

Finally, the administration of tonics, such as arsenic, iron and strychnine, is to be resorted to, and these measures, combined with massage, are the best methods we have for effecting a cure.

Accidental chronic poisoning by the introduction of metallic poisons into the system, is by no means rare, and many deleterious substances have from time to time brought about such serious results as to temporarily or permanently disable the sufferer. This serious condition of affairs has been impressed, on more than one occasion, on the public mind, and as a profession we are constantly meeting with persons suffering from obscure symptoms, that in the end prove to have their origin in

the exposure of the patient to some surrounding medium, which is by him supposed to be innocuous, but which is in reality death dealing.

Of all the poisonous substances used in preparing those things which are intended for our creature comfort, arsenic seems to be the most frequently used and the most poisonous. Medical literature is teeming with the reports of cases of arsenical poisoning from such sources, but it is only recently that attention has been called to the fact that this drug enters into our very sleeping rooms and garments, in the subtilty of varied hues, and the mere lack of green in a wall paper or wearing fabric, proves no longer that the purchaser is not taking into his household that which he least desires. The latest and most complete résumé of this subject which I have been able to find, is the paper by Prof. Edward S. Wood, in the Fifth Annual Report of the State Board of Health, Lunacy and Charity, of Massachusetts (1884). In this excellent and highly valuable report, Prof. Wood proves, beyond all cavil, that not only is the absence of green in a substance, say wall paper, for example, no proof that arsenic is not present, but states that the presence of green is by no means proof of the presence of arsenic; and, consequently, we are unable to judge, except by testing, whether our house walls are poison-laden or healthy. This comes very near home to the writer of this essay, for on looking over the samples of arsenical wall-papers which accompany Prof. Wood's report, he finds that for over a year and a half he has had on the walls of his dining-room, his office, and his hall-way papers which are the counterpart of the samples which Prof. Wood states to be laden with arsenic. According to the researches of Prof. Wood, my office and hall papers contain no less than 3.76 grs. of arsenic to the square yard, while the paper in the dining-room contains even more, viz., 6.27 grs. to the square yard. Fortunately nothing has arisen in the household to swell the number of sufferers from this source. The samples of Dr. Wood represent almost every shade imaginable, and the

quantity of arsenic found in wall papers varies from 0.59 grs. to 6.74 grs. to the square yard.

The descriptions of the results of the analyses of Dr. Wood and colleagues is startling even to those who, from their pursuits as sanitarians, generally are well posted in such matters.

Beside the wall papers analyzed were a large number of glazed papers, of all shades of color, even white and blue papers containing an equal amount of the poison with their more dangerous looking associates. The glazed paper so frequently used in the finishing of the handsome boxes prepared for holding fancy candies contained the drug, and theatre tickets, playing cards, wrapping paper for lozenges and chocolate, and even the glazed papers used in kindergartens, not only contained arsenic, but reeked with it. Some specimens of this glazed paper contained as much as fifty grains to the square yard, and some of it was so strongly saturated with the poison that samples could not be introduced into the report because persons binding such a report suffered from arsenical poisoning arising solely from this source. Rubber dolls, building-blocks, balloons, balls, children's books, and toy candles have all been found to contain this ubiquitous agent, and Dr. Wood obtained arsenic in ladies' dresses made of "tulle" and "Foulard cambric." In the wearers of these dresses conjunctivitis, pharyngitis and gastric irritation occurred, while in a case in the *Lancet* for May 22d, 1880, there appeared a pustular eruption upon the neck and arms after wearing "a splendid dark-green dress, trimmed with light-green leaves, and analysis soon showed that arsenic was the causative agent.

Dr. Jabez Hogg reports cases of arsenical poisoning from the lining of boots, from flannel shirts, gloves, hat linings and paper collars.

In the *Sanitary Record* for April 25th, 1879, p. 271, we find an account of arsenical poisoning in a young man who wore collars of remarkable polish, which analysis showed to be due to the use of arsenic, mixed with the starch, by the laundries into whose hands he commended his neck-wear. Paper collars also

have been found to be arsenic laden, the quantity of arsenic often being in direct ratio to the brilliancy of polish.

In analyzing toy candles Dr. Wood obtained a box of these containing fifty. Fourteen of them were bright green and contained as much as eight grains of arsenite of copper apiece. Such candles he believes to be peculiarly dangerous, since in burning the arsenic is given off with the products of combustion and is borne through the air as an impalpable dust.

This particular danger is only present when *white* arsenic has been used. Prof. Hoffman has estimated that in certain dress-stuffs which he has analyzed, when worn in a ball-room these fabrics would shake off into the atmosphere as great an amount as from twenty to thirty grains of arsenic in an hour. Cretonnes used for covering furniture, chintz window curtains, cloth linings of baby-carriages and bed-hangings, all have been found to be frequently arsenical, and one begins to feel as if his life lay under the edge of an arsenical sword of Damocles.

Dr. Wood says, "the surprising feature of the extensive use of these arsenical papers by children is, that numerous accidents have not occurred and been recorded. This may explain, however, many cases of irritable stomach and indigestion, which have been ascribed to taking cold, or to some indiscretion in diet." Food has also fallen into the hands of persons so unscrupulous as to contaminate it with arsenic, and the *British Medical Journal* of November 8th, 1879, p. 746, gives a case of two children who were taken violently ill after eating a candy-watch, the face of which was composed of a green printed paper, which on being torn off, left some of its pigment sticking to the candy. Analysis showed the green to be due to the presence of arsenite of copper.

Red wines and syrups have also been found to contain arsenic, but in small quantities.

In the *British Medical Journal* for June 23d, 1883, p. 1218, is the following report of the committee of the National Health Society; (a mere abstract of their conclusions can only be given here, owing to lack of space and the fact that many of the arti-

cles named have already been mentioned.) The report mentions lamp-shades, artificial leaves and flowers, rocking-horses, distemper color for decorative purposes, japanned goods generally, venetian and other blinds, carpets, linoleum, book-cloth and fancy bindings.

After reading all this array of articles which are in every-day use and which are, therefore, all the more capable of doing harm, we cannot doubt that many irritative catarrhs of the respiratory and alimentary tracts have a secret origin in these sources, that many obscure cases of renal disease originate in this way, and that numerous cases of eye disease have their origin directly or indirectly in just such a manner.

Prof. Osborne Reynolds says: "Many lives have been sacrificed to the absorption of arsenic from wall papers," and relates the case of a family of six persons, consisting of a father, mother and four children, who were prostrated shortly after having certain rooms in their residence newly papered. Three of the children died before the cause of their sickness was discovered, and the fourth child was at the point of death when the attending physician found that on passing his hand over the wall a green powder came off on his hand, which was proved to be arsenic. Unfortunately the discovery was made too late, for the child died.*

In the *British Medical Journal*, for June 14, 1879, Dr. Jabez Hogg reports the case of a gentleman who was, in some manner, engaged in the transaction of certain business for the royal family. During his stay at a neighboring hotel he suffered from a severe cold and on the third night he occupied apartments at a neighboring cottage, the walls of which proved to be covered by arsenical wall papers. He went to bed, but soon awoke with a severe chill, intense intestinal pain accompanied by nausea. He was too weak to get out of bed to let his condition be known and soon fainted away, not recovering consciousness till next morning, when he was removed from the exposure and soon recovered.

In the *Practitioner*, for 1880, vol. XXIV, p. 235, a report is

* *Sanitary Record*, April 25, 1879.

made of the death of two children of an eminent surgeon from enteritis. After their death the cause of their illness was found to be in the wall paper of their room.

Dr. G. H. Batterbury, in the *British Medical Journal*, for Nov. 18, 1876, thus describes the symptoms from which he suffered: "I have occupied my present rooms since the beginning of the year; previously, I had been perfectly healthy in every respect. About March, I began to be troubled with an irritating cough, with the expectoration of mucus and muco-pus. I noticed especially that every night on going to bed, there was much wheezing and coughing.

* * * * * * * * *

About a month ago, severe conjunctivitis came on, first in the left eye, then in the right, and lastly, both together. This was comparatively mild in the morning, but increased toward night, when there was a plentiful secretion of thick mucus. It was on the appearance of this symptom that my partner, Mr. Wyke Smith, suggested arsenical poisoning. My bed-room paper was innocent of suspicious color; but my sitting-room paper contained a good deal of dark green, among other colors. * * * The sitting room proved to be very arsenical."

Case after case might be given here, from the references which the writer has collected, but one more will be quoted as showing the quantity of this agent which actually is dispersed through the air by wall papers.

In the *British Medical Journal*, for June 21, 1873, we find the report of a case in which arsenical poisoning from wall paper was suspected. Analysis of the dust collected on the top of a wardrobe showed that in every 100 grs. of dust there was 0.20 gr. of white arsenic and 0.36 gr. of Scheele's green. In 48 oz. of the patient's urine, there was found 0.26 gr. of white arsenic and 0.50 gr. of Scheele's green. Wood and Mörner also report like results on examining the urine of such patients.

Dr. Hogg, who seems to have reported more cases of chronic arsenical poisoning than any one else, not only confines his observations to wall papers, but in the *British Medical Journal*,

of Nov. 8, 1879, p. 746, records the case of a lady who suffered from psoriasis around the nails and tips of the fingers, from using arsenical playing cards.

Another case is reported, in a German journal, of a gentleman who bought, in Hamburg, a pair of marine-blue gloves, and wore them. He became ill, and his hands were covered with a peculiar eruption, and the gloves were found, on analysis, to contain arsenic.

Again another case is recorded of a gentleman who wore a pair of stockings colored with aniline red. After a considerable length of time he noticed some discomfort of the feet, which became worse, until large running sores developed on the sole and ankle of each foot; and Dr. Wood records the case of a lady who wore a dress made of "Foulard cambric," and who was poisoned by so doing. Analysis showed the fabric to contain 0.291 grain of arsenic to the square metre.

In this hurried glance at the subject of "Arsenic as a Domestic Poison," as Prof. Wood so aptly puts it, we have not as yet considered the symptoms which its presence induces. The most common sign is the conjunctivitis and the irritation of the passages covered by mucous membrane and exposed to the air. Indigestion, nausea, vomiting and Bright's disease come on. Enteritis is very common in children who are exposed to such sources of evil. A peculiar and irritable condition of the skin asserts itself, which varies in its characteristics according to the susceptibility of the patient. Severe pain in the limbs and belly, and œdema, frequently come on. These are the chief and most important symptoms which will present themselves to the perplexed practitioner, and a lack of any ordinary cause for their onset will aid him in searching for this poison which seems to attack us on all sides. Unfortunately, for the sake of long-suffering humanity, arsenic is not the only metallic poison whose effects are obtained through articles in domestic use, for very recently Bischoff has published a paper,* in which he states that

* Repertorium Anal. Chemie, quoted by *Annales of Hygiene* for July 15th, 1884.

he has found large quantities of antimony, in the form of tartar emetic, in certain fabrics stained with aniline dyes. Investigation proved that the dyers used the drug for the purpose of "fixing" the colors; and Bischoff affirms that the majority of the better quality of cotton goods, stockings, etc., that are "fast colors," dyed with aniline, at the present time contain antimony. In the fabrics examined, he found that the dyers passed the stuffs through sumac baths, and after that, a dye bath containing tartar emetic. By this means a tannate of antimony is formed. Owing to the precipitation of the drug which takes place, much of it is rendered insoluble in water, and by this means much of the danger is escaped. If the manufacturers are careful to see that the goods are well mixed before dyeing, an additional safeguard is reared; but this is, unfortunately, too often overlooked. A case of antimonial poisoning having originated in this manner, the case was taken to the courts, and Bischoff was called upon to make a series of examinations to determine how much antimony each colored fabric contained. He divided his examinations into two series. In one, he determined the amount of antimony obtainable by soaking the yarns in water; in the other series, the amount to be obtained by the use of strong hydrochloric acid. The drug was first precipitated as a sulphide, and when the quanity was sufficient to be weighed, it was converted into antimoniate of antimony, and weighed as such. The quantity found was as follows, the dyes each yielding a different amount of the poison:—

	Per cent. in Water.	Per cent. in HCl.
1. Bluish purple	traces	0.11
2. Bordeaux red	"	0.26
3. Dark purple	0.012	0.12
4. Light garnet	traces	0.24
5. Light blue	"	0.13
6. Dark blue	0.008	0.25
7. Dark garnet	traces	0.244
8. Lighter Bordeaux	"	0.18
9. Bluish purple (Sample No. 2)	"	0.10
10. Carmine red	0.008	0.22
11. Dark cherry red	traces	0.31

	Per cent. in Water.	Per cent. in HCl.
12. Reddish brown	0.0135	0.30
13. Scarlet	0.014	0.20
14. Light blue (Sample No. 2)	traces	0.036
15. Water blue	"	0.11
16. Orange brown	"	0.121
17. Brown purple	"	0.20

He then goes on to say: "A long pair of cotton stockings will weigh, on an average, 60 to 70 grammes" (2 to 2½ ounces). "The maximum quantity of antimony in such a pair would be about the fourth of a gramme, or 4 grains. Only the portion soluble in water is of any physiological importance, and of this there would be not more than one and a half centigrammes."

The statement that only the part soluble in water is of importance, seems to the writer to be rather hasty, or at least to need qualification. Every one knows the solvent power of perspiration, which is emphasized by the abstraction of dye even after clothing has been washed several times, and it seems probable, therefore, that perspiration would dissolve more antimony than pure water. While the proportion of antimony set free during wear is probably somewhat more than one and a half centigrammes, it never amounts to the quantity which can be obtained by the use of hydrochloric acid. As every one knows, when tartar emetic or any other soluble compound of antimony is applied to the skin it produces itching and inflammation, which, if the irritation be kept up for a long period of time, becomes pustular in character, as is seen after the application of antimonial ointment.

Lately, attention has been called by various physicians to a form of lead poisoning which has a curious origin. While the form of the poisoning is hardly different from the ordinary attack, the source is one which would scarcely be thought of, since the means of obtaining the poison seems, per force, to limit the amount of lead to a very minute quantity.* So far as the writer has been able to discover, the first case of this kind

* Half Yearly Abstract for 1886. Art. by Chevallier.

ever reported was made public by M. Chevallier, in 1866. He found that women who made their living by sewing, and who were accustomed to bite the threads with which they sewed, often suffered from lead colic and all the symptoms of chronic lead poisoning, if the practice was adhered to.

Lately, a case has occurred in the practice of a leading physician in this city. The patient, whose trade was that of a tailor, when first seen had the characteristic pallor of lead absorption, the extreme griping pains in the abdomen, the blue line on the gums and constant constipation.* Careful inquiry discovered that he had the habit of biting his threads. Chevallier had found, when examining the history of his cases, that the thread used was heavily coated with sugar of lead, and this same condition of the thread was found to be present in the thread that this man used. Careful questioning at several tailoring establishments of size developed the fact that the employés knew that if they "bit off" their threads they would have "belly-ache," and several of the more intelligent workmen realized the cause of these attacks, saying that the manufacturers of the threads increased the weight of their wares by this means.†

While we cannot doubt the authenticity of these cases, it seems almost incredible that simply *biting* the thread could abstract a sufficient quantity of the lead to bring about poisoning symptoms, and the writer has found that nearly all persons who suffered in this way not only bit off their threads, but also kept them in their mouths for some time, and thus obtained all the lead that could be taken from the article by means of the saliva.

Such cases as these only go to show how even that which at first sight may seem an impossible cause of certain symptoms, may be a more frequent and potential factor in their production

* *Med. News*, Vol. xlviii, No. 21.

† With the object of determining how frequent the "weighting" of dress and sewing silks with lead is, the writer has analyzed a large number of samples obtained from different localities, but has been unable in any case to find the metal. Copper was, however, found quite frequently.

than would be at first imagined, and it is a question whether a majority of physicians would not "pooh-pooh" the very idea of such a possibility unless they had already heard of or seen cases like the one mentioned, and thus realized that the reporters of such cases were persons incapable of making an error in diagnosis.

Closely analogous to the absorption of lead by the system from sewing thread is the subject of lead poisoning from other sources, which, in some cases, antedate the time of this paper; but in other cases lead enters our bodies in such new and attractive forms that it is incumbent on the writer to briefly call your attention to them.

Of all the metallic poisons known, lead acts with the most subtilty and insidiousness, and the powers of the practitioner are often taxed to the utmost to discover the source of the far-reaching drug. But a short time ago a Norwegian bark arrived at New York with its entire crew suffering from chronic lead poisoning of a very severe form. All of them were sent to a hospital, where two of them died and the rest were very ill. Careful investigation fastened the guilt on the ship's water supply, which was contaminated by the lead used in painting the inside of the water tank. Frequent attacks of lead poisoning have also occurred in Paris, due to the same cause, and the Paris Municipal Laboratory has lately issued a recommendation to landlords and householders, who use water from cisterns and tanks, to use a paint, as a lining, which consists of a mixture of tar and benzine, and which contains no lead.

Large quantities of lead are used for purposes of glazing the inside of earthenware vessels and for covering, in an attractive form, iron cooking vessels. Some years ago in the central part of this state an epidemic of acute, violent lead poisoning suddenly sprang up, which was alarming in its suddenness of onset and the number of its victims. For a long time no cause could be found for the poisoning, but finally it was found that the farmers' wives had all been fascinated by a new kind of jar, which was much handsomer and cheaper than the kind they had

heretofore been accustomed to use, and whose lining consisted in a compound of lead which the apple-butter and other edibles containing vegetable acids had formed into the irritating acetate of lead. One of these jars is now in the Museum of the University, and is entirely bereft of its glazed lining by the acid in the food therein stored.

An epidemic of the same character occurred some years ago in the state of New York, and became so prevalent that it received the name of "Dry Cholera," before its true cause was discovered.

Lead, indeed, seems to occur everywhere where it can do harm.

Thus we find in the *British Medical Journal*, for April 7th, 1877, p. 433, an account of two cases, brought before the local magistrates of Manchester, in which the prosecution proved that certain articles of confectionery owed their yellow color to the presence of the chromate of lead.

One ounce of one sample of the sweets contained $\frac{1}{5}$ of a grain of lead; and another sample contained $\frac{2}{5}$ of a grain in the ounce. In a third case a provision dealer of Liverpool was charged with selling a ham called "sugar-cured American," coated with a composition containing the lead chromate, for the purpose of keeping off flies and insects. While no case of poisoning occurred, to the knowledge of the prosecution, Dr. Campbell Brown testified that the substance was injurious to health, and that he believed it possible for the coating to contaminate the meat, and thereby cause serious consequences.

In the same journal for May 19th, 1877, p. 627, Dr. Alford, Med. Officer of Health for Taunton, reports an epidemic of lead poisoning, of considerable extent and violence. The blue line on the gums told unmistakably the cause of the outbreak, but repeated examinations of the water supply, preserves, etc., threw no light on the cause of the trouble. As all the cases occurred in certain isolated families, it became evident that the poison must be obtained not from the immediate surroundings, but from some source common to them all. It was soon dis-

covered that all the families attacked were accustomed to send their grain to be ground at one mill. Dr. Alford proceeded to the mill and ordered the millstones raised. No sooner was this done than it was seen that the stone, being of poor quality, had many holes in its surface, which had been filled up with pure lead. Altogether, at least ten pounds of lead were taken from the holes in the one stone.

It was also remarked that red lead and borax were frequently used for this purpose in grist mills, and that other cases arising from this source had occurred.

The same journal elsewhere describes an epidemic of lead poisoning in an Indian regiment, to whom had been lately issued a new supply of cooking utensils lined with what purported to be pure tin. An analysis of this lining found that the tin was only in very small quantities, while the lead was correspondingly large in quantity. In other words, there was 80 per cent. of lead to every 20 per cent. of tin.

With the increased demands for the comforts and conveniences of life a rapid increase in artificial preservation of food has taken place, and an enormous capital is invested for these purposes. That the supply of preserved goods is not greater than the demand is more readily verified by a glance at the family ash heap, where a profusion of tin cans generally testifies that the housewife is accustomed to give her household many vegetables which, some years ago, at certain seasons, were never seen on the tables of the richest. There can be no doubt that this vegetable food is of the greatest service to those who partake of it, both on account of the vegetable acids contained therein, and from the fact that a much wider range in change of diet can be effected. Fortunately the price of most of these viands is within the reach of the poorest, and no doubt many maladies closely allied to scurvy, arising from a limited diet, are averted. When we take into consideration the enormous amount of this canned food annually consumed, it becomes

evident that the vast majority of it is of good quality and carefully prepared, for it is exceedingly rare to find cases of poisoning from canned goods. Although certain persons interested in other methods of preservation of food frequently circulate reports of cases of metallic poisoning through the use of tin cans, a searching examination of a large library of medical journals, covering a long period of time and representing many countries, fails to bring to light a handful of such cases. It is hardly necessary to remark that the countries in which canned goods are largely used produce the greatest number of cases of poisoning, and for this reason England and America have suffered more often than have those countries on the continent of Europe.

The question as to the amount of metallic matter necessarily present to produce toxic effects, is one of great interest, since many experimenters have discovered varying quantities of metallic salts in a very large number of cases examined by them. A point of great importance in this connection is the frequency with which the metallic salts are ingested. Thus, Orfila found that it took .174 gramme of stannous hydrate to kill guinea-pigs, which would make it necessary for at least three or four drachms of the poison to be present to cause death in a human being, providing we are as susceptible to the poison as the guinea-pig.

Of course, such an amount of stannous hydrate as four drachms could never be dissolved from the surface of any ordinary tin can by the action of the acid contained in the vegetables therein preserved, and for this reason one is at first tempted to believe that no danger exists from this source. More mature thought will bring the mind of the reader to a different conclusion, for it should never be forgotten that all metallic salts act the more insidiously and more seriously when taken into the system in small quantities and constantly, than when a large amount of the poison is ingested at one individual meal. It is probable, therefore, that a much smaller quantity of stannous hydrate than even the quantity required to kill the guinea-pig,

would suffice to produce serious morbid lesions in persons who were accustomed to partake frequently of any kind of canned and acid fruits.

Dr. Attfield, of England, believes that even a small quantity of this salt would so alter the taste of the food as to give warning of its character.

Attfield seems to have been the only observer who failed to find many traces of the metallic salts present in canned goods, and this is quite remarkable, as his examinations were by no means limited to one brand of goods. He states that he analyzed no less than sixteen varieties of goods, and that tin could be found in only a few, and then in very small amounts. The analyses of Onderdonk, of Maryland, Unger and Bodlander, of Germany, and Wynter Blyth, of England, all show lead, tin and zinc to be frequently present in canned goods. Dorsh, in this country, and Menke and Hehner, of England, endorse these results.

Dr. Onderdonk found only two cans of many (number not stated) free from lead. The German observers found tin, as an insoluble stannous compound, to the extent of .04 per cent. Wynter Blyth found in twenty-three samples of canned tomatoes, cranberries, apricots and pineapples, as much as 14.3 grs. per pound of stannous hydrate, the average amount being 5.2 grs. to the pound. In some cans the tin was corroded and even the juice had a metallic taste.

Dorsh found lead and tin as an alloy in a large number of his observations, and as such an alloy is more readily oxidized than tin alone, it is correspondingly dangerous.

Menke, in his analyses, found as much as 1.3 gr. to the pound of stannous compounds, and Hehner, tin in large quantities in many vegetable and animal preserves. Thus, he found $\frac{1}{10}$ gr. to the pound in condensed milk; in canned oysters $\frac{7}{10}$ gr.; in canned soup $\frac{1}{2}$ gr.

By far the most thorough and interesting paper which has been published in regard to this matter, is one by Dr. Fred. T. Doggett, in the *Boston Medical and Surgical Journal*, of July 16th, 1885. This writer states that he has tested "twenty cans of

many brands, from the cheapest to the highest priced, and has always found lead present in the tinning of the cans. The same writer (*loc. cit.*) also reports six cases of poisoning from canned tomatoes, in which all the symptoms pointed to slow metallic poisoning. In three of the cases there was a blue line on the gums and in all the cases lead was evidently the chief causative agent.

In this instance the poison was ingested more rapidly than is ordinary. The whole number of cases occurred in one family, the mother of which stated that, owing to poverty, she had bought a large quantity of canned tomatoes "cheap," and that the family had, for a long time, subsisted entirely on these canned tomatoes.

She also stated that as many as three or four cans were often used in one day, and that the contents of them frequently left a puckered taste in the mouth, which, on one or two occasions, was so bad that she threw the can and its contents away. Dr. Doggett examined what remained of the tomatoes, and found no lead in them, but in several cans obtained from the same source as the original supply he found the sides oxidized and the contents of a metallic taste.

Much of the danger of using canned goods depends on their manner of preparation and preservation. In many cases tartaric acid is used to preserve the fruit, and salicylic acid and borax are also used, even by the best fruit preservers in the country. It has come to the knowledge of the writer that one of the largest and best known wholesale houses in America approached a chemist with the request that he discover the smallest amount of salicylic acid and borax which would preserve fruit, and that he should also determine whether the amount necessary for the purpose would be harmful to those who consumed the food. They stated that they were driven to this by their less scrupulous competitors, who showed wares of greater purity and whiteness, to the eye. The methods of soldering cans has much to do with harming their contents. The "flux" used in soldering the vessel, when filled, rarely consists of resin, as of old. Stannous chloride

is largely used, and frequently dilute acid. Through carelessness the boys, for it falls to these persons to close the cans frequently, let fall into the contents of the vessel some of the "flux" and lead, and, fortunately for us, this laxity of doing things rarely causes much of the metal to enter the can. Much of the tin in the market is alloyed with lead, since an amalgam of these metals is cheaper than is pure tin, and the lead is often present to the extent of from one to ten per cent. Illustrative of this fact, we find that Dr. Magruder* reports a case of severe lead poisoning resulting from eating "canned corn." He analyzed the tin and found a certain amount of lead in it, as an amalgam. Further than this, he discovered that tartaric acid had been added by the manufacturers to the corn, to keep it good, and this afforded a good opportunity for an action of the acid on the metal.

The practitioner should be always careful in placing the blame of an outbreak of sickness in a family upon the supposed presence of lead in the food which has been obtained from cans, for a large number of cases are reported in which a chemical examination failed to show the presence of any metallic salt whatsoever, the cause of the ailments being a decomposed condition of the food itself. A case of this character is to be found in the *British Medical Journal* for November 1st, 1879, p. 707. In this case twenty-one persons, most of whom were adults, partook of Chicago canned corned beef. Shortly afterward, symptoms of corrosive metallic poisoning appeared, in that the gastro-intestinal canal was violently irritated. Chemical analysis failed to show any metal present, but the meat was found to be decomposed, and the whole train of symptoms was produced by the introduction of peptones, ptomaines and the other products of decomposition, into the system of those who ate of the food.

One of the chief causes of the development of acids in cans of preserved food is the entrance of air through some minute crack which has not been closed at the time the can was sealed, or which has been produced by the rough handling to which the cans are subjected before they reach the consumer. This entrance

* *Med. News*, September 8th, 1883, p. 261.

of air is necessary for the development of any fermentation in the contents of the can, and it is this fermentation which produces many of the acids which act on the tin and lead. These acids consist in acetic acid, malic acid, tartaric acid and citric acid, when the cans have been filled with vegetable matter, and in butyric acid, chiefly, when animal matter has been thus preserved. For these reasons canned goods should never be opened, partially used, and the rest put away in the can for future use. Fortunately, for him who is willing to use his eyes, the can in which fermentation has taken place is always "swelled" at the ends, owing to the presence of gas. While this "swelling" is a warning to the purchaser, it does not follow that its absence shows the contents of the can to be of good quality, for there may be so much natural acid in the substance preserved, and so much lead in the tin as to form poisonous salts. Besides this, a certain number of canned goods are annually "reprocessed," which means that when a dealer finds a "swelled can," he sends it back to the manufacturer, who replaces it with a good can immediately, and then, by a certain procedure, in which high heat is used, the cans are treated in such a way as to arrest fermentative changes. These cans are then packed and put on the market, either as new goods, or, if this is not possible, their price is marked down to whatever figure they will bring. While high heat destroys any living entity which the processes of fermentation may have brought about, it has no influence on any metallic salt which may have been developed previous to the "reprocessing," and, consequently, these second-rate goods are more frequently poison-laden than the fresh article. When we consider the great length of time that many canned goods are stowed away, and the various opportunities which are present, both during their preparation and afterward, for the entrance of lead, we must concede that very few cases of poisoning from this source occur, the consumers being scattered through every walk of life, and the manufacturers consisting of every degree of reliability and dishonesty. Before closing the discussion of this interesting subject, the writer will state that the metallic salts most frequently found are the hydrate

and chloride of tin and the tartrate and acetate of lead. Of the two tin salts, the chloride is by far the most poisonous, and is, fortunately, less frequently met with, and in smaller quantity, than the hydrate. It is hardly necessary to remark that the acetate and tartrate of lead are exceedingly poisonous and harmful in their action.

Recently, at a meeting of the Medical Society of London,* Dr. W. B. Haddon reported a case of chronic poisoning from the bisulphide of carbon, in a man aged forty-five, whose employment was found in an india-rubber factory. The man first suffered from weakness in the legs, with increasing loss of power, and also of coördination, so that his gait was staggering and undecided. A fellow-workman also had symptoms of much the same character, for which he was being treated at St. Thomas' Hospital. Dr. Richardson, who made some remarks on the case, stated that the chronic form of poisoning by this agent had been first described by Delpech, in 1866, and that he himself had frequently used the bisulphide as an anæsthetic for destroying dogs.

A disease, which is not new in its origin, but which is becoming more and more frequent every day, is the loss of hearing, from which workers in machine shops often suffer. This trouble arises among all persons who are, by reason of their occupation, subjected to loud noises, and engineers, firemen and boiler makers are the persons who are the most frequently attacked. The latter class are affected in such numbers that the disease has been given the name of "boiler-makers' deafness," and they themselves have a language of signs, which, according to Roosa,† is quite elaborate, and on which they rely almost entirely while at work. The position occupied by these men while at work, in many instances, exposes them to a constant din, the like of which is rarely found elsewhere. Often they are stretched at full length inside the

* The *Lancet*, January 2d, 1886.

† Treatise on Diseases of the Ear, p. 358.

boiler, the joints of which they are riveting, while heavy blows are being delivered on the inside and outside surfaces of the iron by their fellow-laborers.

Blacksmiths and workmen employed about the shops in which are run large dynamos, for the production of electricity for lighting purposes, are also often temporarily or permanently deafened by the noise around them; and, finally, telegraph operators, at work in offices in which are many other instruments in use, become so dulled in their hearing powers that they cannot catch the sound of their own instrument with sufficient clearness to receive a message correctly. Naturally the disease is one whose intensity is exceedingly variable, the degree of intensity depending largely on idiosyncrasy, or the presence of any other aural disease previous to the entering on the noisy labors. The quality, pitch and volume of the sound are all strong factors in the etiology of this affection, and the permanency of the condition is as thoroughly dependent on the surroundings while at work as is the severity of the attack in point of degree. It is hardly necessary to state that the louder the noise, and the more constant the din, the more vehement are the symptoms. The metallic noises, that is, those produced by the concussion of large masses of resonant metal against each other, seem to produce more evil effects than those noises which depend on the striking together of smaller pieces of like substances, or pieces of wood.

Attention should be paid to the fact that this form of deafness is entirely separate from that form which arises after the subjection of the person to any single and solitary loud sound, as, for example, the report of a gun held near the head. In the latter case the bones of the ear are frequently jammed by the excessive vibration, in such a manner that they become anchylosed and immovable. There exists some difference of opinion in regard to the portion of the auditory apparatus affected in "boiler-makers' deafness," but the best authorities agree that the chief lesion is a paralysis of the auditory nerve in its terminal endings.*

* See Am. System Practical Medicine, article on Medical Otology, by Strawbridge, vol. iv, p. 934.

Dr. St. John Roosa, of New York (*loc. cit.*), insists very strongly that this opinion is correct. Every otologist knows that in disease of the middle ear, of certain kinds, hearing is improved when the person is surrounded by a great din, as in the cars, or in a machine shop. While to the ordinary reader such a statement seems rather paradoxical, the fact is nevertheless true, but cannot be discussed in this paper, since the subject has no direct bearing on the disease before us, having been merely brought in parenthetically in order to make the words of Dr. Roosa more clear. He says "that boiler makers do suffer from a lesion of the internal ear, and not of the middle ear, I do not think admits of doubt. The very fact that they do *not* hear better in a noise is an incidental proof that they suffer from a lesion of the labyrinth." Again he says: "Boiler makers, and those who become deaf from an exposure to the continuous shock of loud sounds, suffer a lesion of the acoustic nerve." Politzer* states that continuous noises act upon the ear, causing an irritation and paralysis of the auditory nerve, and quotes Gottstein and Kayser,† who found that among blacksmiths good hearing was very rare. In 28 per cent. of those who were examined by them, there was a considerable diminution, or total absence, of perception through the bones of the head.

Although paralysis of the auditory nerve does take place in many cases of *boiler-makers' deafness*, certain eminent authorities state that the deafness produced in the persons of locomotive engineers and firemen arises from still another source. Moos‡ sought for the cause of the disorders of hearing in this class of persons in the continued severe shaking to which they are exposed, and the persistent straining of the ear, in the piercing draughts, and the continued irritation of the pharynx, by the inhalation of injurious vapors escaping from the engine. The pathological changes which he found consisted, in a large number of cases, in a chronic sclerosis of the middle ear. The same authority states that these conclusions have been reached by Schwabach and Pollnow, Hedinger§ and Güterbock.

* Diseases of the Ear, p. 748.
† Bresl. ärztl. Zeitschr., 1881.
‡ Politzer, *loc. cit.*
§ Deutsche med. Wochenschr., 1882.

THE COCAINE HABIT.

No drug possessing the powers belonging to the Erythroxylon coca can long remain unabused by the man whose system, from one cause or another, craves some article which will place him beyond the reach of certain worries or anxieties which may be real or imagined, it matters not which. For many years the coca eater in South America has been a more familiar spectacle than is the opium eater in this country, and the symptoms produced by the abuse of this drug are so marked that any one can point out the user of this article on the street. The eyes are sunken and red, and are surrounded by great dark rings. The gait is tottering and weak; the muscles soft and flabby; the intellect slow and drowsy; the appetite for ordinary food is gone; the only thing which satisfies the burning, craving desire for food is coca.

Any one who studies carefully the effects of identical samples of drugs upon different nationalities, must have discovered that the plants of a region from which the individual comes affect him differently from the manner in which they act on foreigners.

The Oriental is more agreeably affected by opium than is the inhabitant of North America, and the peculiar condition of the user of haschish is seldom seen elsewhere than in India. This peculiar susceptibility, or insusceptibility, whichever you may choose to call it, of native users of certain drugs, must depend on certain idiosyncrasies of temperament or physiological condition, and the same rule seems to hold good in regard to the excessive devourer of coca. In the South American the effects are particularly delightful, while in the inhabitant of North America the symptoms are not by any means so pleasant. While quite a large number of cases of the "cocaine habit" have been reported, none of them had progressed far enough to produce any serious effects. One of the most severe cases which have come to the writer's notice is one in which the man was in the habit, every hour and a half through the day, of giving himself a hypodermic injection of the hydrochlorate of cocaine. At the time he was first taken in charge by his attending physician, he

was taking in this manner no less than fifteen grains of the drug a day. His digestion was wretched, and dark rings encircled his eyes. His intellect was slow and feeble, and during the whole twenty-four hours he was in a condition of drowsiness or dosing. All over his body were small abscesses, due to the frequent and incessant use of the syringe. In this case the whole supply of cocaine was stopped immediately, or within the first twenty-four hours, after he came under treatment. Instead of being tortured by a horrible feeling of uneasiness, so frequently seen on the withdrawal of morphia from the opium fiend, or the withdrawal of alcohol from the "whiskey soaker," he merely suffered for the next twenty-four hours from general wretchedness and sick stomach, and begged piteously for hypodermic doses of cocaine. From the results obtained in this case, on suddenly withdrawing the usual dose of the drug, it seems probable that cocaine does not possess the power over the cerebral hemispheres which belongs to morphia and alcohol, and that, consequently, there is not as much mental and nervous disturbance present as is seen in chronic poisoning by other drugs.

The writer would certainly be remiss if he did not call the attention of the reader to the evil effects often produced by other drugs which have, of late years, come into general use. Aside from the latest innovation, namely, cocaine, which has just been dwelt upon, accidents from certain medicaments, such as chloral, chloroform and ether, almost constantly are met with. Nitrous oxide, until a few weeks ago, was believed to be the most harmless anæsthetic that we possessed, but the experience of Dr. Duchesne, of Paris, who has recently had a patient under his care die while the anæsthetic was being used, proves that it is not as trustworthy as many dentists and others believe. It would be impossible to take into consideration here the new drugs of the last fifty years, which are powerful enough, in large amounts, to produce positive symptoms or death. Chloroform and chloral are, perhaps, the most lethal drugs which have owed their existence to the advances of our knowledge, for, unlike active

principles derived from plants, they owe their appearance to the researches of the chemist, who has not found them as hidden yet ever-existing agents, but has evolved them from inanimate things. Salicylic acid produces death, if in sufficient quantity, bringing on the peculiar green color of the urine so pathognomonic of the sufferer's trouble. Carbolic acid changes the urine to a dark and dirty brown, due to its action on the kidneys and on the corpuscular elements of the blood.

Antipyrin, one of the newest remedies for hyperpyrexia, sometimes produces a uniform scarlet eruption over the whole surface of the body, which disappears when the drug is withdrawn. Jaborandi and its active principle, pilocarpine, also are very powerful drugs, when given even in small amounts, and nitrite of amyl has, in some instances, produced death by apoplexy.

So on, many drugs might be held to view as producing untoward effects, did space permit, but as the changed conditions brought about by such agents are hardly fair examples of the subject of this paper, nothing more about them will be said.

The *Trichina spiralis*, while not produced by the advances of civilization during the last half century, has only been recognized as a causative agent in the production of certain severe symptoms within the last few years. Indeed, its presence was never known till Paget, in 1835, described it, and, like many other important discoveries of equal import, it sank into almost total oblivion, to be discovered again by Leidy, in 1846, who did not, however, recognize the fact that it produced dangerous symptoms. The discovery of Paget was in the human muscle, while the observations of Leidy were on the muscles of the hog. The writer would have been more correct if he had mentioned the name of Owen as a contemporary of Paget, for it is to him that we owe the name of this curious parasite, and not to later observers.

In 1860, Zenker, of Dresden, treated a case of what he supposed was typhus fever, but which presented the symptom of

intense pain in the muscles. At the post-mortem the muscles were found swarming with trichinæ, and the typhoid symptoms were, of course, attributed to their presence. About the same period, the investigations of Leuckart confirmed the opinions previously expressed as to the pathology of the disease. Friederich first showed the presence of the worm in the living human subject, and to him belongs the credit of having diagnosticated the first case correctly.

The parasites most frequently enter the human system through the eating of raw or partially cooked meat, particularly ham and sausage, for it is in the pig that trichinæ seem to find their best abode. Whether their frequency in the muscles of this creature depends on the fact that hogs eat all sorts of food, and often substances contaminated with the fecal matter of other animals, it is impossible to state; but this is the more likely, since trichinæ have been found in the intestinal canal of nearly all domestic mammals, and yet not in the muscles of locomotion. Indeed, the Trichina spiralis is classed by Leidy and other eminent authorities among the intestinal worms. As a general rule, these parasites are taken into the stomach encysted in the calcareous capsules with which they become covered while in the muscle of the hog or other mammal. These calcareous capsules are dissolved by the gastric juice, and the occupant of each cell is free to move down the intestinal canal and reproduce its species with the rapidity common to such low forms of life.* Dr. Leidy states that an adult female trichina only reaches this adult stage after her cyst has been dissolved, and that she then brings forth an enormous number of active living embryos, which are no sooner freed from the maternal worm than they begin to penetrate the surrounding muscles, first in the intestines, and finally reaching the extremities. They become fixed in the muscles, and are soon covered by a cyst of calcareous matter, attaining the same point of growth as did their parents. If the flesh of an animal in this stage be ingested, the same train of occurrences takes place; but if, on the contrary, the animal survives the

* Leidy states that each female produces over a thousand living embryos.

attack, and lives for some years, the parasites die in their cysts. The apex of the capsule undergoes a fatty degeneration, and the worms die synchronously with the invasion of their covering.

That the animals do not solely migrate through the muscles has been long since proved, as they have been found in the blood vessels in large numbers; but it is generally conceded that the penetration of the muscles is by far the most frequent manner of invasion. The symptoms produced are oftentimes exceedingly severe, and the prognosis of such cases is nearly always bad, the only favorable factors being the history of mild symptoms, and of having partaken sparingly of the infected flesh. That this last point is liable to fallacy is shown by the fact that specimens have been obtained in which a single ounce of meat has contained no less than 100,000 worms. When such a multitude of parasites infest so limited an area, a very small quantity of meat carries with it the nucleus of an enormous colony of trichinæ. The majority of deaths occur about the sixth week, and appear to be due to the invasion of the respiratory muscles, for it should not be forgotten that these parasites enter the diaphragm as well as other muscles.

The first symptoms are those of gastric uneasiness, which passes into violent diarrhœa, which depends largely for its character upon the susceptibility of the sufferer to intestinal irritation. Pain in the muscles now comes on; often it is most excruciatingly severe, and increased with every movement. Even the rotation of the eyeball from side to side causes pain, due to the presence of the parasites in the orbital muscles. Fever may or may not be present, the chief factor in its production being the amount of gastro-intestinal irritation produced. There is loss of appetite and flesh, the muscles appear relaxed and flabby, and neuralgic pains dart through the body. One of the symptoms of the disorder is the œdema all over the body, and some observers state that the disease is diagnosticated from other forms of sudden œdema, by the fact that a peculiar puffiness appears, before the general œdema, about the bridge of the nose. So far as the writer knows, no one has explained the why

and wherefore of this curious symptom. In certain severe cases the parasites invade the pleura and peritoneum, and even the lung tissue is attacked. As a consequence, peritonitis and pleurisy often terminate severe cases of this malady.

Of the two symptoms which are said to invariably occur, one has already been mentioned, namely, the œdema; the other is profuse sweating, which comes on early in the attack, and lasts throughout its whole course. Children generally suffer less than adults, probably because, their bowels being more readily distended, the parasites are carried out before they have time to act.

If the patient survives the seventh week the prognosis is very hopeful, because, by the expiration of this period, most of the migrating parasites have become encysted and harmless. The treatment of this affection is, of course, almost useless, since we have no vermicide which will affect the "muscular trichinæ" without also injuring the man; for it is an unbending law that the less highly specialized an organ or being be, the less susceptible is it to attacks on its vitality.

ACTINOMYCOSIS.

With a brief glance at one other form of human parasite, this paper will be brought to a close. Scarcely eight years have elapsed since Bollinger described in the ox, and James Israel* in man, the first examples of this curious disease. Since that time case after case has found its way into medical literature, particularly in Germany. While it can hardly be possible that this micro-organism has only come into existence of late years, we were absolutely ignorant of its being until 1877.

The Actinomyces is a parasitic fungus, of peculiar shape, somewhat resembling a rosette. It is made up of a mycelium, out of which simple or clubbed cells arise. The parasite so affects the bone which it attacks that peculiar nodular formations are induced, which are largely made up of epithelial and giant cells, and which are readily taken for tubercles.

* For Israel's latest paper on this subject, see Klinische Beiträge zur Kentniss der Actinomykose des Menschen. Berlin, 1885. Or short abstract in the *Amer. Jour. of the Med. Sci.*, April, 1886, p. 602.

In man these formations generally suppurate, while in the ox suppuration is rarely seen, the growth becoming very large and hard.

This disease is divided into three groups, according to the portion of the organism attacked. The first group is that in which the disease is most typical, namely, when the parasite infests the lower jaw; the second class includes those cases in which the fungus attacks the respiratory passages and upper portion of the body; and the third division is represented by the growth of the micro-organism in the intestinal tract or elsewhere in the abdominal viscera. This arrangement of the groups is in the same order as is the case of diagnosticating the disease. In the jaw and mouth the symptoms point so markedly to the affection that but little care is necessary when differentiating the case, since the fungus is visible to the naked eye as a small, yellow, gritty body, more or less thickly scattered through the pus. Some observers have considerable confidence, as a diagnostic point, in the shape of the opening in the cheek leading to the bone, stating that it also is nearly always star-shaped, having radiating sinuses or depressions. In nearly all cases affecting this portion of the system, the entrance of the parasite has been through a broken or decayed tooth. Even when the disease appears in the mouth and fauces, its entrance generally takes place through this medium. Some few cases are, however, believed to have originated by the entrance of the fungus into some fissure of the tongue or buccal mucous membrane.

In the second group of cases the symptoms are often so diverse and general as to render diagnosis almost impossible, unless some direct exposure to the disease has been undergone by the sufferer previous to his coming under treatment. This diversity of symptoms is readily accounted for when the range of infection in this region is considered, for no organ in the thoracic cavity is exempt from their attacks. In the greater number of cases the parasite infests the bronchial mucous membrane, while in others it attacks the lung tissue itself. Under the former conditions the symptoms are often anything but pronounced, the

patient frequently passing the space of a year before he is sufficiently annoyed to seek advice. When the disease affects the pleura or the diaphragm, the symptoms are greatly increased in rapidity of onset and severity. The fungus spreads rapidly to the costal and mediastinal tissues, and caries of the ribs has resulted from their inroads. Even the heart muscle itself has been found riddled by the parasite. When the fungus is as general as this, metastatic actinomycotic abscesses are frequent in their occurrence, extending hither and thither through the organism, involving the skin and glandular tissues, and producing cerebral complications of sufficient severity only to show that brain abscess must be present, although its cause is not readily discovered.

The third series of symptoms may originate primarily or secondarily, that is, either by the organisms beginning life in the intestinal canal, into which they have gained access by means of the food, or by their extension or metastasis from the thoracic cavity to the abdominal viscera. It is in the former case that diagnosis is most difficult. Very rarely can the patient or the practitioner discover, even if the idea occur to him, whether or not the food has contained actinomyces, and the symptoms simulate those of so many other and more frequent types of abdominal disease, that all treatment is necessarily purely empirical, which, after all, is all that treatment for this disease can amount to. The fact that the disease has already affected the respiratory tissues, producing symptoms extending to the abdominal apparatus, of course, aids the physician in forming, at least, an opinion. By the invasion of the muscular wall of the gut, they bring about diarrhœa of great severity, or, perhaps, obstinate constipation, while the peritoneum, if attacked, generally resents their presence by violent inflammation. In the intestinal walls, when the parasites infest them, much the same nodules appear as are seen in the face and jaws, as already described; suppuration invariably comes on under these circumstances, and perforation of the gut often ends the scene. Although the disease is really of greater frequency in Germany than else-

where, both among man and animals, the parasite is by no means of rare occurrence in the United States, at least among the brute creation. As illustrative of this point, the following experience of a friend of the writer may be cited:—

Desiring to make a close and careful study of these parasitic fungi, he proceeded to several large slaughtering houses, asking the butchers to be on the lookout for cattle with "lumpy or swelled jaw." To his queries most of the men denied any knowledge of the condition, while the few who had seen the disease thought it rare. Failing to obtain any specimens of the disease, he at last one day rather hastily said he would give two dollars for every "lumpy jaw" which they would bring to his house. In the course of a week he was so overrun with butchers bearing jaws nodulated by the fungus that he was forced to retract his offer.

Although mankind seem in this country to have escaped, to a great extent, quite a number of cases have been recorded in American journals, two cases having, of late, appeared in Chicago.

As already insinuated, the fungus generally enters the system through the food, and is transferred from animal to animal by the dropping of actinomycotic saliva or pus on the sides of the mangers, or the fodder supplied to the cattle.

Nearly every case of the disease in man, so far witnessed, has had a history of contamination from some domestic animal, and care should, therefore, be exercised in the handling of such brutes, that none of the saliva or pus is brought in contact with any portion of the body in which there is a solution of the normal continuity. For this reason, and for the protection of other animals, also, the beasts affected with "lumpy jaw" should be despatched with rapidity as soon as the disease asserts itself. It is hardly necessary to add that the flesh of such an animal is unfit for sale.

For a valuable paper on actinomycosis in man, see "Contributions from the Surgical Clinic in Tübingen, 1886; article by P. Mossbrugger."